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**US Army Corps
of Engineers®**
Albuquerque District

**SPECIFICATIONS
FOR
SAMPLE PROJECT 0001**

REMODEL PHS MEDICAL FACILITY

**IMMIGRATION AND NATURALIZATION SERVICE
FLORENCE, ARIZONA**

"INCREASE PROFIT - SUBMIT VECPS"

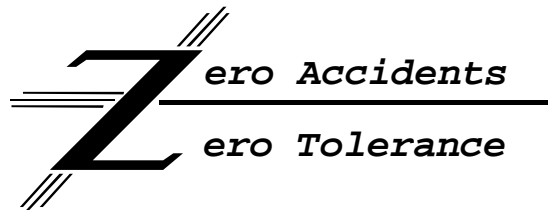


TABLE OF CONTENTS

DIVISION 2 - SITE WORK

SECTION 02050 - DEMOLITION

DIVISION 3 - CONCRETE

NOT USED

DIVISION 4 - MASONRY

NOT USED

DIVISION 5 - METALS

SECTION 05500 - MISCELLANEOUS METAL

DIVISION 6 - WOOD AND PLASTICS

SECTION 06100 - ROUGH CARPENTRY

SECTION 06410 - CUSTOM CASEWORK

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

SECTION 07270 - FIRESTOPPING

SECTION 07900 - JOINT SEALING

DIVISION 8 - DOORS AND WINDOWS

SECTION 08110 - STEEL DOORS AND FRAMES

SECTION 08520 - ALUMINUM WINDOWS

SECTION 08700 - BUILDERS' HARDWARE

SECTION 08810 - GLASS AND GLAZING

DIVISION 9 - FINISHES

SECTION 09250 - GYPSUM WALLBOARD

SECTION 09510 - ACOUSTICAL CEILINGS

SECTION 09650 - RESILIENT FLOORING

SECTION 09900 - PAINTING, GENERAL

DIVISION 10 - SPECIALTIES

SECTION 10160 - TOILET PARTITIONS

SECTION 10800 - TOILET ACCESSORIES

DIVISION 11 - EQUIPMENT

NOT USED

DIVISION 12 - FURNISHINGS

NOT USED

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13958 - FORCED ENTRY RESISTANT COMPONENTS

DIVISION 14 - CONVEYING SYSTEMS

NOT USED

DIVISION 15 - MECHANICAL

SECTION 15250 - THERMAL INSULATION FOR MECHANICAL SYSTEMS

SECTION 15330 - WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION

SECTION 15405 - PLUMBING, HOSPITAL

SECTION 15488 - GAS PIPING SYSTEMS

SECTION 15565 - HEATING SYSTEM; GAS-FIRED HEATERS

SECTION 15653 - AIR CONDITIONING SYSTEM (UNITARY TYPE)

SECTION 15895 - AIR-SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM

SECTION 15990 - TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS

DIVISION 16 - ELECTRICAL

SECTION 16262 - AUTOMATIC TRANSFER SWITCHES

SECTION 16415 - ELECTRICAL WORK, INTERIOR

SECTION 16640 - CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)

SECTION 16721 - FIRE DETECTION AND ALARM SYSTEM

SECTION 16741 - PREMISES DISTRIBUTION SYSTEM AND TELEPHONE

SECTION 02050

DEMOLITION

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ENGINEERING MANUALS (EM)

EM 385-1-1 (1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.2 GENERAL REQUIREMENTS

The work includes demolition and removal of resulting rubbish and debris. Rubbish and debris shall be removed from Government property daily, unless otherwise directed, to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of occupational safety and health, the work shall be performed in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections. In the interest of conservation, salvage shall be pursued to the maximum extent possible; salvaged items and materials shall be disposed of as specified.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-08 Statements

Work Plan; GA.

The procedures proposed for the accomplishment of the work. The procedures shall provide for safe conduct of the work, including procedures and methods to provide necessary supports, lateral bracing and shoring when required, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations in accordance with EM 385-1-1.

1.4 DUST CONTROL

The amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

1.5 PROTECTION

1.5.1 Protection of Personnel

During the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, may be allowed to remain standing without additional bracing, shoring, or lateral support until demolished. The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.2 Protection of Existing Property

Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government; any damaged items shall be repaired or replaced as approved by the Contracting Officer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.3 Protection From the Weather

The interior of buildings to remain and salvageable materials and equipment shall be protected from the weather at all times.

1.6 USE OF EXPLOSIVES

Use of explosives shall not be permitted.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXISTING STRUCTURES

Interior walls, other than retaining walls and partitions, shall be removed to top of concrete slab on ground.

3.2 UTILITIES

Existing utilities shall be removed as indicated. When utility lines are encountered that are not indicated on the drawings, the Contracting Officer shall be notified prior to further work in that area.

3.3 DISPOSITION OF MATERIAL

Title to material and equipment to be demolished, except Government salvage and historical items, is vested in the Contractor upon receipt of notice to proceed. The Government will not be responsible for the condition, loss or damage to such property after notice to proceed.

3.3.1 Material Salvaged for the Contractor

Material salvaged for the Contractor shall be stored as approved by the Contracting Officer and shall be removed from Government property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

3.4 CLEAN UP

Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

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SECTION 05500 - MISCELLANEOUS METAL

PART 1 - GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(1980) Designation System for Aluminum Finishes
AA SAA-46	(1978) Standards for Anodized Architectural Aluminum

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A14.3	(1992) Ladders - Fixed - Safety Requirements
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(1993a) Structural Steel
ASTM A 53	(1993) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 283	(1993) Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 446	(1993) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
ASTM A 475	(1989) Zinc-Coated Steel Wire Strand
ASTM A 500	(1993) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 525	(1993) General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM B 26	(1992a) Aluminum-Alloy Sand Castings
ASTM B 221	(1992a) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM B 429	(1992a) Aluminum-Alloy Extruded Structural Pipe and Tube

ASTM D 2047 (1982; R 1988) Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1 (1994) Structural Welding Code - Steel

FEDERAL SPECIFICATIONS (FS)

FS AA-S-271 (Rev D; Am 1) Shelving, Storage and Display, Steel, Interchangeable, Nut and Bolt Type

FS AA-S-1048 (Basic) Shelving, Storage and Display, Steel, Clip Type

FS RR-C-271 (Rev D) Chains and Attachments, Welded and Weldless

FS RR-G-1602 (Rev C) Grating, Metal, Other Than Bar Type (Floor, Except for Naval Vessels)

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM-01 (1988) Metal Finishes Manual for Architectural and Metal Products

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 211 (1992) Chimneys, Fireplaces, Vents and Solid Fuel-Burning Appliances

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-04 Drawings

Miscellaneous Metal Items; FIO.

Detail drawings indicating material thickness, type, grade, and class; dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates. Detail drawings for the following items shall be submitted.

- a. Partitions, diamond-mesh type.
- b. Roof scuttles.
- c. Shelving.
- d. Ladders.
- e. Miscellaneous

1.3 GENERAL REQUIREMENTS

The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1. Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with ASTM A 123, ASTM A 446, or ASTM A 525, as applicable. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

1.4 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.

1.5 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

1.6 ANCHORAGE

Anchorage shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; and lag bolts and screws for wood.

PART 2 - PRODUCTS

2.1 ALUMINUM FINISHES

Unless otherwise specified, aluminum items shall have anodized finish conforming to AA SAA-46. The thickness of the coating shall be not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in

exterior locations in AA DAF-45. Items to be anodized shall receive a polished satin finish pretreatment and a clear lacquer overcoating.

2.2 SHOP PAINTING

Surfaces of ferrous metal except galvanized surfaces, shall be cleaned and shop coated with the manufacturer's standard protective coating unless otherwise specified. Surfaces of items to be embedded in concrete shall not be painted. Items to be finish painted shall be prepared according to manufacturer's recommendations or as specified.

2.3 LADDERS

Ladders shall be steel or aluminum, fixed rail type in accordance with ANSI A14.3.

2.4 CHAIN LINK FENCE FABRIC

ASTM A 392, Class 1, zinc-coated steel wire with minimum coating weight of 1/2 ounces of zinc per square foot of coated surface, or ASTM A 491, Type I, aluminum-coated steel wire. Fabric shall be fabricated of 9 gauge wire woven in 2 inch mesh. Fabric height shall be as indicated on the drawings. Fabric shall be knuckled on the top and bottom selvage. Gates shall be the type size and swing shown. ASTM F 900 and /or ASTM F 1184. Gate frames shall conform to strength and coating requirements of ASTM F 1083 for Group IA, steel pipe, with external coating Type A, nominal pipe size (NPS) 1-1/2. Gate frames shall conform to strength and coating requirements or ASTM F 1043, for Group IC, steel pipe with external coating Type A or Type B, nominal pipe size (NPS) 1 1/2.

2.5 ROOF SCUTTLES

Roof scuttles shall be of galvanized steel not less than 1.994 mm (14 gauge), with 75 mm (3 inch) beaded flange welded and ground at corners. Scuttle shall be sized to provide minimum clear opening of 940 by 760 mm (37 by 30 inches). Cover and curb shall be insulated with 25 mm (1 inch) thick rigid insulation covered and protected by galvanized steel liner not less than 0.5512 mm (26 gauge). The curb shall be equipped with an integral metal cap flashing of the same gauge and metal as the curb, full welded and ground at corners for weathertightness. Scuttle shall be completely assembled with heavy hinges, compression spring operators enclosed in telescopic tubes, positive snap latch with turn handles on inside and outside and neoprene draft seal. Fasteners shall be provided for padlocking on the inside. The cover shall be equipped with an automatic hold-open arm complete with handle to permit one hand release.

2.6 SHELVING

Shelving shall conform to FS AA-S-271, Kind 1, Class 1, Type I. Minimum dimensions and number of shelves shall be as indicated.

2.7 STAINLESS STEEL PANELS AND BENCHES

Panels and benches shall be stainless steel and shall meet ASTM A 167 or ASTM A 240: 18-8, Type 302, and shall have a polished to No. 4 finish. Stainless steel panels and benches shall be the thickness and size shown in the

drawings. The benches shall be provided with support members. The contractor shall submit drawings of the benches for approval.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

All items shall be installed at the locations shown and according to the manufacturer's recommendations. Items listed below require additional procedures as specified.

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SECTION 06100
ROUGH CARPENTRY**PART 1 - GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN FOREST AND PAPER ASSOCIATION (AFPA)

AFPA-T901 (1991; Supple 1993; Addenda Apr 95) National Design Specification for Wood Construction

AFPA T11-WCD1 (1988) Manual for Wood Frame Construction

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1995) Basic Hardboard

AHA A194.1 (1985) Cellulosic Fiberboard

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A208.1 (1993) Particleboard

APA-THE ENGINEERED WOOD ASSOCIATION (APA)

APA Form E30 (1996) Design/Construction Guide, Residential and Commercial

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 79 (1994) Gypsum Sheathing Board

ASTM C 208 (1995) Cellulosic Fiber Insulating Board

ASTM C 552 (1991) Cellular Glass Thermal Insulation

ASTM C 553 (1992) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

ASTM C 665 (1994) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

ASTM C 1136 (1992) Flexible, Low Permeance Vapor Retarders for Thermal Insulation

ASTM D 2898 (1994) Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing

ASTM E 84	(1996a) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM F 547	(1977; R 1990) Definitions of Terms Relating to Nails for Use with Wood and Wood-Base Materials

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C9	(1995) Plywood - Preservative Treatment by Pressure Processes
AWPA C27	(1993) Plywood - Fire-Retardant Pressure Treatment
AWPA M4	(1995) Standard for the Care of Preservative-Treated Wood Products
AWPA P5	(1996) Standards for Waterborne Preservatives

DEPARTMENT OF COMMERCE (DOC)

DOC PS 1	(1996) Voluntary Product Standard - Construction and Industrial Plywood
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FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825c	(1997) Approval Guide Building Materials
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NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

NHLA-01	(1994) Rules for the Measurement & Inspection of Hardwood & Cypress
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NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA-01	(1993) Standard Grading Rules for Northeastern Lumber
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SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

SCMA-01	(1986; Supple No. 1, Aug 1993) Standard Specifications for Grades of Southern Cypress
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SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB-1001	(1994) Standard Grading Rules for Southern Pine Lumber
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WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB Std 17	(1993) Supples III (A), V (A), & VI (A)) Grading Rules for West Coast Lumber
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WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA-01 (1995; Supple Nos. 1, 2, and 3) Western Lumber
Grading Rules 95

FEDERAL SPECIFICATIONS (FS)

FS RR-F-221/2 (Rev. A) Fencing Wire (Woven Wire and Netting,
Fabric) (Detail Specification)

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-01 Data

Nailers and Nailing Strips; FIO.

Drawings of field erection details, including materials and methods of fastening nailers in conformance with Factory Mutual wind uplift rated systems specified in other Sections of these specifications.

SD-13 Certificates

Grading and Marking; FIO.

Manufacturer's certificates (approved by an American Lumber Standards approved agency) attesting that lumber and material not normally grade marked meet the specified requirements. Certificate of Inspection for grade marked material by an American Lumber Standards Committee (ALSC) recognized inspection agency prior to shipment.

Insulation; FIO.

Certificate attesting that the cellulose, perlite, glass and mineral fiber, polyurethane, or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well ventilated areas, and protected from extreme changes in temperature and humidity. Laminated timber shall be handled and stored in accordance with AITC 111 or APA EWS R540.

PART 2 - PRODUCTS

2.1 LUMBER

2.1.1 Grading and Marking

2.1.1.1 Lumber Products

Solid sawn and finger-jointed lumber shall bear an authorized gradestamp or grademark recognized by ALSC, or an ALSC recognized certification stamp, mark, or hammerbrand. Surfaces that are to be exposed to view shall not bear grademarks, stamps, or any type of identifying mark. Hammer marking will be permitted on timbers when all surfaces will be exposed to view.

2.1.2 Sizes

Lumber and material sizes shall conform to requirements of the rules or standards under which produced. Unless otherwise specified, lumber shall be surfaced on four sides. Unless otherwise specified, sizes indicated are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.

2.1.3 Treatment

Exposed areas of treated wood that are cut or drilled after treatment shall receive a field treatment in accordance with AWP A M4. Items of all-heart material of cedar, cypress, or redwood will not require preservative treatment, except when in direct contact with soil. Except as specified for all-heart material of the previously mentioned species, the following items shall be treated:

- a. Wood members in contact with or within 455 mm (18 inches) of soil.
- b. Wood members in contact with water.
- c. Wood members exposed to the weather including those used in built-up roofing systems or as nailing strips or nailers over fiberboard or gypsum-board wall sheathing as a base for wood siding.
- d. Wood members set into concrete regardless of location, including flush-with-deck wood nailers for roofs.
- e. Wood members in contact with concrete that is in contact with soil or water or that is exposed to weather.

2.1.3.1 Lumber

Lumber shall be treated in accordance with AWP A C2 with waterborne preservatives listed in AWP A P5 to a retention level as follows:

- a. 4 kg per cubic meter (0.25 pcf) intended for above ground use.
- b. 6.4 kg per cubic meter (0.40 pcf) intended for ground contact and fresh water use.

2.1.4 Moisture Content

At the time lumber and other materials are delivered and when installed in the work their moisture content shall be as follows:

- a. Treated and Untreated Lumber : 100 mm (4 inches) or less, nominal thickness, 19 percent maximum.

b. Materials Other Than Lumber: In accordance with standard under which product is produced.

2.1.5 Miscellaneous Wood Members

2.1.5.1 Nonstress Graded Members

Members shall include bridging, corner bracing, furring, grounds, and nailing strips. Members shall be in accordance with TABLE I for the species used. Sizes shall be as follows unless otherwise shown:

Member	Size (inch)
Corner bracing	1 x 4.
Furring	1 x 2.
Nailing strips	1 x 3 or 1 x 4 when used as shingle base or interior finish, otherwise 2 inch stock.

2.1.5.2 Sill Plates

Sill plates shall be standard or number 2 grade.

2.2 ACCESSORIES AND NAILS

Markings shall identify both the strength grade and the manufacturer. Accessories and nails shall conform to the following:

2.2.1 Anchor Bolts

ASTM A 307, size as indicated, complete with nuts and washers.

2.2.2 Bolts: Lag, Toggle, and Miscellaneous Bolts and Screws

Type, size, and finish best suited for intended use. Finish options include zinc compounds, cadmium, and aluminum paint impregnated finishes.

2.2.3 Nails and Staples

ASTM F 547, size and type best suited for purpose; staples shall be as recommended by the manufacturer of the materials to be joined. In general, 8-penny or larger nails shall be used for nailing through 25 mm (1 inch) thick lumber and for toe nailing 50 mm (2 inch) thick lumber; 16-penny or larger nails shall be used for nailing through 50 mm (2 inch) thick lumber. Nails used with treated lumber and sheathing shall be galvanized. Nailing shall be in accordance with the recommended nailing schedule contained in AFPA T11-WCD1. Where detailed nailing requirements are not specified, nail size and spacing shall be sufficient to develop an adequate strength for the connection. The connection's strength shall be verified against the nail capacity tables in AFPA-T901. Reasonable judgement backed by experience shall ensure that the designed connection will not cause the wood to split. If a

load situation exceeds a reasonable limit for nails, a specialized connector shall be used.

2.3 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown. R-values shall be determined at 24 degrees C (75 degrees F) in accordance with ASTM C 518. Insulation shall contain the highest practicable percentage of recovered material which has been recovered or diverted from solid waste, but not including material reused in a manufacturing process. Where two materials have the same price and performance, the one containing the higher recovered material content shall be provided. Insulation shall be the standard product of a manufacturer and factory marked or identified with manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Materials containing more than one percent asbestos will not be allowed.

2.3.1 Batt or Blanket

2.3.1.1 Glass Fiber Batts and Rolls

Glass fiber batts and rolls shall conform to ASTM C 665, Type I unfaced insulation, Class A, having a UL rating of 25 and a smoke developed rating of 150 or less when tested in accordance with ASTM E 84. Insulation shall have a 0.25 mm (10 mil) thick, white, puncture resistant woven-glass cloth with vinyl facing on one side. Width and length shall suit construction conditions.

2.3.1.2 Mineral Fiber Batt

Mineral fiber batt shall conform to ASTM C 665, Type I unfaced insulation

2.3.1.3 Mineral Fiber Blanket

Mineral fiber blanket shall conform to ASTM C 553, Type I, Class 6. Blankets shall be sized to suit construction conditions, resilient type for use below and above ambient temperature to 195 degrees C (350 degrees F). Blankets shall have a factory applied vapor-barrier facing on one side with 50 mm (2 inch) nailing tabs on both edges. Vapor barriers shall be fire retardant, high vapor transmission, and aluminum foil laminated to crepe paper type conforming to ASTM C 1136, Type II. Nominal density shall be 12 kg per cubic meter (0.75 pcf).

2.3.1.4 Acoustical Batt or Blanket Insulation

ASTM C 665, Mineral fiber, Type I unfaced insulation, width as required for steel stud construction."

2.3.2 Sill Sealer

Mineral wool, 25 mm (1 inch) thick and compressible to 0.8 mm (1/32 inch), width of sill, designed to perform as an air, dirt, and insect seal in conformance with ASTM C 665, Type I.

PART 3 - EXECUTION**3.1 INSTALLATION OF MISCELLANEOUS WOOD MEMBERS****3.1.1 Nailers and Nailing Strips**

Nailers and nailing strips shall be provided as necessary for the attachment of finish materials. Nailers used in conjunction with roof deck installation shall be installed flush with the roof deck system. Stacked nailers shall be assembled with spikes or nails spaced not more than 450 mm (18 inches) on center and staggered. Beginning and ending nails shall not be more than 150 mm (6 inches) for nailer end. Ends of stacked nailers shall be offset approximately 300 mm (12 inches) in long runs and alternated at corners. Anchors shall extend through the entire thickness of the nailer. Strips shall be run in lengths as long as practicable, butt jointed, cut into wood framing members when necessary, and rigidly secured in place. Nailers and nailer installation for Factory Mutual wind uplift rated roof systems specified in other Sections of these specifications shall conform to FM P7825c.

3.1.2 Furring Strips

Furring strips shall be provided at the locations shown. Furring strips shall be installed at 400 mm (16 inches) on center unless otherwise shown, run in lengths as long as practicable, butt jointed and rigidly secured in place.

3.1.3 Sill Plates

Sill plates shall be set level and square and anchor bolted at not more than 1800 mm (6 feet) on centers and not more than 300 mm (12 inches) from end of each piece. A minimum of two anchors shall be used for each piece.

3.2 INSTALLATION OF INSULATION

Insulation shall be installed after construction has advanced to a point that the installed insulation will not be damaged by remaining work. For thermal insulation the actual installed thickness shall provide an R-value of 30 in roof and 19 in walls. For acoustical insulation the installed thickness shall be as shown. Insulation shall be installed on the weather side of such items as electrical boxes and water lines. Unless otherwise specified, installation shall be in accordance with the manufacturer's recommendation.

Impaling of insulation on spindle or prong-type insulation anchors will not be permitted. Insulation installed above ceilings shall be laid over the top of the bottom chords of joists and held in place with poultry netting. Poultry netting shall be tied to the chords with tie wire. Edges of batts or blankets shall be butted together to form a continuous seal.

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SECTION 06410 - CUSTOM CASEWORK

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A208.1 (1989) Wood Particleboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1036 (1991) Flat Glass

ASTM D 1037 (1991) Evaluating the Properties of Wood-Base Fiber and Particle Panel Materials

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI-02 (1988) Architectural Woodwork Quality Standards, Guide Specifications, and Quality Certification Program

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.5 (1992) Auxiliary Locks and Associated Products

BHMA A156.9 (1988) Cabinet Hardware

BHMA A156.18 (1987) Materials and Finishes

HARDWOOD PLYWOOD MANUFACTURERS ASSOCIATION (HPMA)

HPMA HP-1 (1992) Interim Voluntary Standard for Hardwood and Decorative Plywood

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3 (1991) High-Pressure Decorative Laminates

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-01 Data

Custom Casework; FIO.

Manufacturer's catalog data, including standard color charts.

SD-04 Drawings

Custom Casework; FIO.

Drawings shall show each type of casework, counters, cabinets, and related items, and shall clearly indicate the complete layout of the cabinets and accessories, and pertinent details of construction, fabrication and attachments.

SD-06 Instructions

Custom Casework; FIO

Manufacturer's instructions shall include assembling, installation, finishing, and maintenance instructions.

SD-14 Samples

Custom Casework; GA.

Plastic Laminate; GA.

Samples shall be submitted with the drawings. In lieu of individual samples, complete minimum size casework may be furnished as samples. Mock-up units are not acceptable. Samples shall include the following items:

- a. Door and drawer fronts - one of each type, with hardware mounted.
- b. Countertop and backsplash - one section, 4-inches wide, containing both.
- c. Plastic laminate color samples, 3 by 6 inches.

1.3 DELIVERY, HANDLING, AND STORAGE

The Contractor shall protect materials from damage during delivery, when stored, and during construction. Damaged and defective materials shall be removed and replaced with new. Cabinet work shall be constructed, or delivered and brought into the building, only after the building has dried out, following the installation of wet materials, and when there is no danger of damage to materials due to excessive moisture. Mill-fabricated

cabinets and casework shall be delivered to the project [unsealed and ready to receive the specified finish.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

Casework, including cabinets and counters, shall be flush overlay design and shall be custom built, either at a mill or in-place in the building. Casework shall be premium grade, and unless otherwise specified, shall be built to the quality standards specified in AWI-02 for cabinets and casework. Design shall be as indicated on the drawings.

2.1.1 Particleboard

Wood particleboard shall be a mat-formed particleboard conforming to ANSI A208.1, Type I (interior) medium density, Grade 1-M-2. Board shall be laminated construction, composed of large wood flakes at the core and finer wood flakes at each surface. Flakes shall be coated and bonded with urea-formaldehyde resin under heat and pressure-formed into boards. When tested in accordance with ASTM D 1037 and in addition to complying with the properties listed in ANSI A208.1, water absorption shall not exceed 15 percent in 24 hours, swelling thickness shall not exceed 6 percent in 24 hours, and maximum moisture content shall not exceed 7 percent. Wood particleboard intended for use as exposed or semi-exposed shelving or casework shall be sanded and sealed on both surfaces; exposed edges shall be trimmed with 20 by 10 mm (3/4- by 3/8-inch) solid poplar, birch, or oak, with tongue-and-groove joint or butt joint glued to the particleboard with water-resistant glue.

2.1.2 Construction

Construction shall be plumb, square, and true; accurately milled and fabricated to details with clean-cut profiles and lines. Accurately size the cabinets, counters, and casework to the indicated dimensions. Surfaces shall be flat, true, free of planer marks or other marks, and smoothly sanded. Select best wood pieces with most uniform grain and color for exposed surfaces. Where possible, conceal fastenings; where not possible, locate fastenings in inconspicuous places. Where nailing is permitted on exterior exposed faces, conceal nailheads. Do not fasten with exposed nails in hardwood. Mortise, tenon, spline, house, joint, block, nail, screw, glue, or bolt together, as approved, in manner to provide rigidity, to avoid swelling or shrinking, and to insure work to remain in place without warping, splitting, and opening of joints. Furnish and securely install cleats, nailers, strips, blocking, hangers, anchors, moldings, and the like, required to neatly and securely install cabinets, counters, and casework.

2.1.2.1 Framing

Cabinets and counters, constructed in place shall have frame fronts and solid ends, or frame construction throughout. Frame member shall be 20 by 38 mm (3/4- by 1-1/2-inch) kiln-dried hardwood, mortised and tenoned, dovetailed or doweled, and glued together. Top and bottom corners shall be braced with hardwood blocks that are glued with water-resistant glue and nailed in place. Continuous back panels shall be provided for all mill-fabricated counters, cabinets, shelving, and casework. Back panels shall be 6.4 mm (1/4-inch)

minimum thick hardwood plywood, sound grade, or 3.2 mm (1/8-inch) tempered hardboard when painted or concealed. Exposed or semi-exposed backs shall be hardwood plywood of the same veneer as the face of the cabinet. Bottoms of cabinets shall be minimum 10 mm (3/8-inch) plywood good grade and shall be braced with wood members glued in place. Cabinet ends shall be 16 mm (5/8-inch) thick medium density particleboard core with hardwood veneers. Shelves shall be fully adjustable and shall be minimum 16 mm (5/8-inch) thick particleboard.

2.1.2.2 Counter and Cabinet Bases

Bases shall be constructed of 2-inch thick wood framing, members cut to fit, with toe space of the indicated height and depth. Cross rails shall be provided at cabinet ends, points of concentrated loads, and intervals not to exceed 24 inches.

2.1.2.3 Doors and Drawer Fronts

Door design shall be solid flush face. Flush doors shall be hardwood plywood with matching solid hardwood edges. Lipped doors shall be hardwood plywood with lumber core. Doors and drawer fronts, including edges, shall be covered with shop-applied plastic laminate.

2.1.2.4 Countertops and Backsplashes

Countertops and backsplashes shall be constructed of plywood, Grade B-D or better, or particleboard and covered with shop-applied plastic laminate. Countertops shall be at least 3/4-inch thick. Backsplash shall be plywood, Grade B-D or better or particleboard, 20 mm (3/4-inch) thick. Unless otherwise indicated, backsplashes shall be not less than 3-1/2 inches high.

2.1.3 Fasteners and Adhesives

2.1.3.1 Nails

Nails shall be steel casing nails with flat countersunk cupped head and diamond point.

2.1.3.2 Adhesives

Adhesives shall be moisture- and mold-resistant. Adhesive shall also be contact type for adhering plastic laminate sheets.

2.1.3.3 Wood Screws

Wood screws shall be carbon steel or brass. Wood screws exposed to view shall be brass with an oval head with cross recess drive.

2.2 CABINET HARDWARE

Cabinet finish hardware shall conform to the types and styles of BHMA A156.9. Screws and attachments shall be finished to match the hardware item. Finishes shall be in accordance with BHMA A156.18 and shall match that of the builders' hardware specified in Section 08700 BUILDERS' HARDWARE unless otherwise specified.

2.2.1 Shelf Supports**2.2.1.1 Flush-Applied Supports**

Flush-applied, adjustable shelf supports shall be B24071, wrought brass, nickel plated with 13 mm (1/2-inch) increment adjustment slots and with provision for screw fastening 6 inches on vertical center.

2.2.1.2 Shelf Rests

Shelf rests shall be Type B24081, wrought brass, nickel plated. Rests shall have a minimum projection of 20 mm (3/4-inch) and a minimum width of 14 mm (9/16-inch). Shelf rests for use in drilled holes shall be B84013, wrought steel, nickel plated with 6.4 mm (1/4-inch) diameter pin, 10 mm (3/8-inch) long, overall length 1-1/4 inches.

2.2.2 Cabinet Hinges

Cabinet hinges shall be wrought steel or brass, designated size and finish and shall conform to BHMA A156.9, as follows:

Concealed hinges for flush doors shall be B81501.

2.2.3 Cabinet Catches

Cabinet catches shall be B43142, magnetic catches, aluminum case, minimum 4-pound pull.

2.2.4 Pulls

Door and drawer pulls shall be B12011, contemporary-design, cast bronze, 3-inch centers, screw attached from inside of door or drawer.

2.2.5 Drawer Slides

Drawer slides shall be B85051, ball bearing full extension drawer slides for attachment to each side of drawer. Rubber stops shall be provided at striking points.

2.2.6 Locks

Locks shall conform to BHMA A156.5 and shall be all brass, pin-tumbler type, as follows:

a. Drawer locks and cabinet locks shall be type E27021, half-mortise, 5 or more pin tumblers, 22 mm (7/8-inch) diameter cylinder, 10 mm (3/8-inch) throw dead bolt with brass strike.

2.3 PLASTIC LAMINATES**2.3.1 CounterTops, Edges, and Backsplashes**

Countertop surface, edge, and backsplash shall be covered with high-pressure plastic laminate, general-purpose type, conforming to NEMA LD 3, Type GP50.

Color, pattern, and finish shall be as indicated on the ROOM FINISH AND COLOR SCHEDULE.

2.3.2 Vertical Surfaces

Plastic laminate surfaces for drawer and counter fronts, exposed-to-view ends, and doors shall be high-pressure plastic laminate, general purpose type, conforming to NEMA LD 3, Type GP38. Color, pattern, and finish shall be as indicated on the ROOM FINISH AND COLOR SCHEDULE.

2.4 SINK RIMS

Sink rims shall be corrosion resistant steel, clamping type, sized to the sink, and a standard product of a manufacturer regularly producing this type of equipment.

PART 3 - EXECUTION

3.1 GENERAL

Casework shall be installed only when temperature and humidity conditions approximate the interior conditions that will exist when the building is occupied. The relative humidity in the building at the time of installation of materials shall be within the limits recommended by the manufacturer. Casework shall be installed level, plumb, and true to line, and shall be attached to the walls or floors with concealed toggle bolts. Countertops, accessories, and hardware shall be installed as indicated. Closure and filler strips and finish moldings shall be provided as required. Make neat, close-fitting cut-outs for indicated sinks, plumbing, and other items projecting through tops. Carefully locate cut-outs for pipes so that edges of holes will be covered by escutcheons. The inner edge of sink cut-outs shall be painted with a coat of semigloss enamel paint; sink flanges shall be set in a bed of sealants. Prior to final acceptance, the Contractor shall aline all doors, adjust all hardware, and leave cabinets in a clean and neat condition.

3.1.1 Counters

Conceal fastenings where practicable, fit the counter neatly, install in a rigid and substantial manner, and scribe to adjoining surfaces. Provide counter sections in the longest lengths practicable; keep joints in tops to a minimum; and where joints are necessary, provide tight hairline joints drawn up with concealed-type heavy pull-up bolts. Glue joints with water-resistant glue and, in addition, make rigid and substantial with screws, bolts, or other approved fastenings.

3.1.2 Nailing

Exposed nailing shall be countersunk finishing nails; the countersunk holes shall be filled with a matching wood filler or putty. Staples shall not be permitted in exposed cabinet or casework.

3.1.3 Finishing

Exposed wood surfaces shall be machine sanded at the mill to the specified standard and then shall receive a final sanding at the site to a smooth clean

finish, free of machine or tool marks, abrasions, raised grain, or similar imperfections.

3.2 APPLICATION OF PLASTIC LAMINATE

Plastic laminate shall be a continuous sheet of the longest length practicable. Joints in the surface sheeting shall be tight and flush, and held to a practical minimum number. Apply with contact type adhesive, type as recommended by the manufacturer of the laminate, applied to both surfaces. The edging and trim shall consist of strips of laminate cut and fitted to all exposed edges with approved contact adhesive.

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SECTION 07270

FIRESTOPPING

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 84	(1995a) Surface Burning Characteristics of Building Materials
ASTM E 814	(1994b) Fire Tests of Through-Penetration Fire Stops

UNDERWRITERS LABORATORIES (UL)

UL-05	(1995; Supple) Fire Resistance Directory
UL 723	(1993; Rev Apr 1994) Test for Surface Burning Characteristics of Building Materials
UL 1479	(1994) Fire Tests of Through-Penetration Firestops

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-04 Drawings

Firestopping Materials; FIO.

Detail drawings including manufacturer's descriptive data, typical details, installation instructions and the fire-test data and/or report as appropriate for the fire resistance rated construction and location. Submittal shall indicate the firestopping material to be provided for each type of application. When more than 5 penetrations are to receive firestopping, drawings shall indicate location and type of application.

SD-13 Certificates

Firestopping Materials; FIO.

Certificates attesting that firestopping material complies with the specified requirements. The label or listing of the Underwriters Laboratories will be acceptable evidence. In lieu of the label or listing, a written certificate may be submitted from an approved, nationally recognized testing agency equipped to perform such services, stating that the items have been tested and conform to the specified requirements and testing methods.

Installer Qualifications; FIO.

Certification stating that installer is qualified and trained to install the specified firestopping material.

Inspection; FIO.

Manufacturer's representative certification stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

1.3 GENERAL REQUIREMENTS

Firestopping shall consist of furnishing and installing a material or a combination of materials to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint.

1.4 STORAGE AND DELIVERY

Materials shall be delivered in the original unopened packages or containers showing name of the manufacturer and the brand name. Materials shall be stored off the ground and shall be protected from damage and exposure to elements. Damaged or deteriorated materials shall be removed from the site.

1.5 INSTALLER QUALIFICATIONS

Installer of firestopping material shall be trained by the manufacturer or the manufacturer's representative, and shall have a minimum of 3 years experience in the installation of firestopping of the type specified.

PART 2 - PRODUCTS**2.1 FIRESTOPPING MATERIALS**

Firestopping materials shall consist of commercially manufactured products complying with the following minimum requirements:

2.1.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E 84 or UL 723. Material shall be an approved firestopping material as listed in UL-05.

2.1.2 Toxicity

Material shall be nontoxic to humans at all stages of application.

2.1.3 Fire Resistance Rating

Firestopping will not be required to have a greater fire resistance rating than that of the assembly in which it is being placed.

2.1.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph GENERAL REQUIREMENTS, shall provide "F" and "T" fire resistance ratings in accordance with ASTM E 814 or UL 1479, except that T Ratings are not required for penetrations smaller than or equal to a 100 mm (4 inch) nominal pipe or 0.01 square meter (16 square inches) in overall cross sectional area.

2.1.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph GENERAL REQUIREMENTS, and gaps such as those between floor slabs or roof decks and curtain walls shall be the same as the construction in which they occur.

PART 3 - EXECUTION**3.1 PREPARATION**

Areas to receive firestopping shall be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system.

3.2 INSTALLATION

Firestopping material shall completely fill void spaces regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping for filling floor voids 100 mm (4 inches) or more in any direction shall be capable of supporting the same load as the floor is designed to support or shall be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Firestopping shall be installed in accordance with manufacturer's written instructions. Firestopping shall be provided in the following locations, except in floor slabs on grade:

a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.

b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.

c. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.

d. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.

e. Construction joints in floors and fire rated walls and partitions.

f. Other locations where required to maintain fire resistance rating of the construction.

3.3 INSPECTION

Firestopped areas shall not be covered or enclosed until inspection is complete and approved. A manufacturer's representative shall inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements.

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SECTION 07900

JOINT SEALING

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509	(1994) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 570	(1995) Oil- and Resin-Base Caulking Compound for Building Construction
ASTM C 734	(1993) Low-Temperature Flexibility of Latex Sealants After Artificial Weathering
ASTM C 834	(1995) Latex Sealants
ASTM C 920	(1994) Elastomeric Joint Sealants
ASTM C 1085	(1991) Butyl Rubber-Based Solvent-Release Sealants
ASTM D 1056	(1991) Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1565	(1981; R 1990) Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Open-Cell Foam)
ASTM E 84	(1996a) Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-01 Data

Backing; FIO.

Bond-Breaker; FIO.

Sealant; FIO.

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). A copy of the Material Safety Data Sheet shall be provided for each solvent, primer or sealant material.

SD-13 Certificates

Sealant; FIO.

Certificates of compliance stating that the materials conform to the specified requirements.

1.3 ENVIRONMENTAL REQUIREMENTS

The ambient temperature shall be within the limits of 4 to 32 degrees C (40 to 90 degrees F) when the sealants are applied.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the job in the manufacturer's original unopened containers. The container label or accompanying data sheet shall include the following information as applicable: manufacturer, name of material, formula or specification number, lot number, color, date of manufacture, mixing instructions, shelf life, and curing time at the standard conditions for laboratory tests. Materials shall be handled and stored to prevent inclusion of foreign materials. Materials shall be stored at temperatures between 4 and 32 degrees C (40 to 90 degrees F) unless otherwise specified by the manufacturer.

PART 2 - PRODUCTS

2.1 BACKING

Backing shall be 25 to 33 percent oversize for closed cell and 40 to 50 percent oversize for open cell material, unless otherwise indicated.

2.1.1 Rubber

Cellular rubber sponge backing shall be ASTM D 1056, Type 1, open cell, Class A, Grade 1 round cross section.

2.1.2 PVC

Polyvinyl chloride (PVC) backing shall be ASTM D 1565, Grade VO 12, open-cell foam, round cross section.

2.1.3 Synthetic Rubber

Synthetic rubber backing shall be ASTM C 509, Option I, Type I preformed rods.

2.1.4 Neoprene

Neoprene backing shall be ASTM D 1056, closed cell expanded neoprene cord Type 2, Class C, Grade 2C2 open cell neoprene sponge Type 1, Class C, Grade 1C3.

2.2 BOND-BREAKER

Bond-breaker shall be as recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

2.3 PRIMER

Primer shall be non-staining type as recommended by sealant manufacturer for the application.

2.4 CAULKING

Oil- and resin-based caulking shall be ASTM C 570.

2.5 SEALANT**2.5.1 LATEX**

Latex Sealant shall be ASTM C 834.

2.5.2 ELASTOMERIC**2.5.3 ACOUSTICAL**

Rubber or polymer-based acoustical sealant shall have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E 84. Acoustical sealant shall have a consistency of 250 to 310 when tested in accordance with ASTM D 217, and shall remain flexible and adhesive after 500 hours of accelerated weathering as specified in ASTM C 734, and shall be non-staining.

2.5.4 BUTYL

Butyl sealant shall be ASTM C 1085.

2.5.5 PREFORMED

Preformed sealant shall be polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealant capable of sealing out moisture, air and dust when installed as recommended by the manufacturer. At temperatures from minus 34 to plus 71 degrees C (30 to plus 160 degrees F), the sealant shall be non-bleeding and shall have no loss of adhesion.

2.6 SOLVENTS AND CLEANING AGENTS

Solvents, cleaning agents, and accessory materials shall be provided as recommended by the manufacturer.

PART 3 - EXECUTION**3.1 GENERAL****3.1.1 Surface Preparation**

The surfaces of joints to receive sealant or caulk shall be free of all frost, condensation and moisture. Oil, grease, dirt, chalk, particles of mortar, dust, loose rust, loose mill scale, and other foreign substances shall be removed from surfaces of joints to be in contact with the sealant. Oil and grease shall be removed with solvent and surfaces shall be wiped dry with clean cloths. For surface types not listed below, the sealant manufacturer shall be contacted for specific recommendations.

3.1.2 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, the materials shall be removed by sandblasting or wire brushing. Laitance, efflorescence and loose mortar shall be removed from the joint cavity.

3.1.3 Steel Surfaces

Steel surfaces to be in contact with sealant shall be sandblasted or, if sandblasting would not be practical or would damage adjacent finish work, the metal shall be scraped and wire brushed to remove loose mill scale. Protective coatings on steel surfaces shall be removed by sandblasting or by a solvent that leaves no residue.

3.1.4 Aluminum Surfaces

Aluminum surfaces to be in contact with sealants shall be cleaned of temporary protective coatings. When masking tape is used for a protective cover, the tape and any residual adhesive shall be removed just prior to applying the sealant. Solvents used to remove protective coating shall be as recommended by the manufacturer of the aluminum work and shall be non-staining.

3.1.5 Wood Surfaces

Wood surfaces to be in contact with sealants shall be free of splinters and sawdust or other loose particles.

3.2 APPLICATION

3.2.1 Masking Tape

Masking tape shall be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Masking tape shall be removed within 10 minutes after joint has been filled and tooled.

3.2.2 Backing

Backing shall be installed to provide the indicated sealant depth. The installation tool shall be shaped to avoid puncturing the backing.

3.2.3 Bond-Breaker

Bond-breaker shall be applied to fully cover the bottom of the joint without contaminating the sides where sealant adhesion is required.

3.2.4 Primer

Primer shall be used on concrete masonry units, wood, or other porous surfaces in accordance with instructions furnished with the sealant. Primer shall be applied to the joint surfaces to be sealed. Surfaces adjacent to joints shall not be primed.

3.2.5 Sealant

Sealant shall be used before expiration of shelf life. Multi-component sealants shall be mixed according to manufacturer's printed instructions. Sealant in guns shall be applied with a nozzle of proper size to fit the width of joint. Joints shall be sealed as detailed in the drawings. Sealant shall be forced into joints with sufficient pressure to expel air and fill the groove solidly. Sealant shall be installed to the indicated depth without displacing the backing. Unless otherwise indicated, specified, or recommended by the manufacturer, the installed sealant shall be dry tooled to produce a uniformly smooth surface free of wrinkles and to ensure full adhesion to the sides of the joint; the use of solvents, soapy water, etc., will not be allowed. Sealants shall be installed free of air pockets, foreign embedded matter, ridges and sags. Sealer shall be applied over the sealant when and as specified by the sealant manufacturer.

3.3 CLEANING

The surfaces adjoining the sealed joints shall be cleaned of smears and other soiling resulting from the sealant application as work progresses.

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SECTION 08110

STEEL DOORS AND FRAMES

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 236	(1989; R 1993) Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box
ASTM C 976	(1990) Thermal Performance of Building Assemblies by Means of a Calibrated Hot Box
ASTM D 2863	(1991) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
ASTM E 152	(1981a) Fire Tests of Door Assemblies
ASTM E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

DOOR AND HARDWARE INSTITUTE (DHI)

DHI-A115.IG	(1994) Installation Guide for Doors and Hardware
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NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM HMMA 862	(1987) Hollow Metal Manual; Section: Guide Specifications for Commercial Security Hollow Metal Doors and Frames
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1992) Fire Doors and Windows
NFPA 80A	(1993) Protection of Buildings from Exterior Fire Exposures
NFPA 101	(1994) Safety to Life from Fire in Buildings and Structures

STEEL DOOR INSTITUTE (SDOI)

SDOI SDI-100	(1991) Standard Steel Doors and Frames
SDOI SDI-107	(1984) Hardware on Steel Doors (Reinforcement - Application)

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-13 Certificates

Fire Rated Doors; FIO.

Thermal Insulated Doors; FIO.

Security Doors; FIO.

Sound Rated Doors; FIO

a. Certification of Oversized Fire Doors: Certificates of compliance in accordance with the requirements of ASTM E 152 for fire doors exceeding the sizes for which label service is available.

b. Certification of Security Door, Thermal Insulating Rating: Certification or test report for doors shall show compliance with the specified requirements. The certification, or test report, shall list the parameters and the type of hardware and perimeter seals used to achieve the rating.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the site and shall be stored in an upright position in accordance with DHI-A115.IG.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 - PRODUCTS

2.1 DOORS AND FRAMES

Doors and frames shall be factory fabricated in accordance with SDOI SDI-100 and the additional requirements specified herein. Door grade shall be heavy duty (Grade II). Exterior doors and frames shall be designation A40 galvanized. Doors and frames shall be prepared to receive hardware conforming to the templates and information provided under Section 08700 - BUILDERS' HARDWARE. Frames shall be welded type. Door frames shall be furnished with a minimum of three jamb anchors and one floor anchor per jamb. Anchors shall be not less than 1.2 mm (18 gauge) steel or 4.5 mm (7 gauge) diameter wire. For wall conditions that do not allow the use of a floor anchor, an additional jamb anchor shall be provided. Rubber silencers shall

be furnished for installation into factory predrilled holes in door frames. Exterior doors shall have top edges closed flush and sealed against water penetration.

2.2 FIRE RATED DOORS

Fire rated door assemblies shall bear the listing identification label of a nationally recognized testing laboratory qualified to perform tests of fire door assemblies in accordance with ASTM E 152 and having a listing for the tested assemblies. The fire resistance rating shall be as shown. Listing identification labels shall be permanently applied by a method which results in their destruction should they be removed.

2.3 THERMAL INSULATED DOORS

Thermal insulated doors shall be filled with rigid plastic foam permanently bonded to each face panel. The thermal conductance (U-value) through the door shall not exceed 2.33 W/sq m times K (0.41 btu/hr times sq f times f) when tested as an operational assembly in accordance with ASTM C 236 or ASTM C 976. Doors with cellular plastic cores shall have a minimum oxygen index rating of 22 percent when tested in accordance with ASTM D 2863.

2.4 SECURITY DOORS

Security type doors and frames shall be factory fabricated in accordance with NAAMM HMMA 862 and the additional requirements specified herein. Doors and frames shall be galvanized 2.3 mm (12 gauge) construction. Doors shall have 2.3 mm (12 gauge) steel plate on both sides, and be internally reinforced vertically with continuous 1.0 mm (20 gauge) steel stiffeners spaced 6 inches on center. Doors shall be fully welded construction with no visible seams or joints. Door thickness shall be 44.5 mm (1-3/4 inches).

2.5 SOUND RATED DOORS

Sound rated doors shall be provided at locations shown in the drawings. Door assemblies shall consist of door, frame, and adjustable perimeter seals. The assembly shall have a Sound Transmission Class (STC) rating of 35 when tested in accordance with ASTM E 90.

2.5 WEATHERSTRIPPING

Unless otherwise specified in Section 08700 - BUILDERS' HARDWARE, weatherstripping shall be as follows: Weatherstripping for head and jamb shall be manufacturer's standard elastomeric type. Air leakage rate of weatherstripping shall not exceed 0.31 l/s per linear meter (0.20 cfm per linear foot) of crack when tested in accordance with ASTM E 283 at standard test conditions.

2.6 FACTORY FINISH

Doors and frames shall be phosphatized and primed with standard factory primer system.

PART 3 - EXECUTION**3.1 INSTALLATION**

Installation shall be in accordance with DHI-A115.IG. Preparation for surface applied hardware shall be in accordance with SDOI SDI-107. Rubber silencers shall be installed in door frames after finish painting has been completed; adhesively applied silencers are not acceptable. Installation and operational characteristics of fire doors shall be in accordance with NFPA 80, NFPA 80A and NFPA 101. Hollow metal door frames shall be solid grouted in all masonry walls and steel stud walls where shown.

3.2 FIELD PAINTED FINISH

Steel doors and frames shall be field painted in accordance with Section 09900 - PAINTING, GENERAL. Weatherstrips shall be protected from paint.

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SECTION 08520

ALUMINUM WINDOWS

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1980) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 101 (1993) Voluntary Specifications for Aluminum and Poly(Vinyl Chloride) (PVC) Prime Windows and Glass Doors

AAMA 603.8 (1992) Voluntary Performance Requirements and Test Procedures for Pigmented Organic Coatings on Extruded Aluminum

AAMA 605.2 (1992; Addenda Feb 1994) Voluntary Specification for High Performance Organic Coatings on Architectural Aluminum Extrusions and Panels

AAMA 1503.1 (1988) Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 283 (1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

ASTM E 547 (1993) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A39.1 (1991; A39.1a) Safety Requirements for Window Cleaning

INSECT SCREENING WEAVERS ASSOCIATION (ISWA)

ISWA IWS 089 (1990) Recommended Standards and Specifications
for Insect Wire Screening (Wire Fabric)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (1994) Safety to Life from Fire in Buildings and
Structures

SCREEN MANUFACTURERS ASSOCIATION (SMA)

SMA 1004 (1987) Aluminum Tubular Frame Screens for Windows

1.2 WINDOW PERFORMANCE

Aluminum windows shall be designed to meet the following performance requirements. Testing requirements shall be performed by an independent testing laboratory or agency.

1.2.1 Structural Performance

Structural test pressures on window units shall be for positive load (inward) and negative load (outward) in accordance with ASTM E 330. After testing, there shall be no glass breakage, permanent damage to fasteners, hardware parts, support arms or actuating mechanisms or any other damage which could cause window to be inoperable. There shall be no permanent deformation of any main frame, sash or ventilator member in excess of the requirements established by AAMA 101 for the window types and classification specified in this section.

1.2.2 Air Infiltration

Air infiltration shall not exceed the amount established by AAMA 101 for each window type when tested in accordance with ASTM E 283.

1.2.3 Water Penetration

Water penetration shall not exceed the amount established by AAMA 101 for each window type when tested in accordance with ASTM E 547.

1.2.4 Thermal Performance

Thermal transmittance for thermally broken aluminum windows with insulating glass shall not exceed R-Value Class 0.59 m/W (R3.33) when tested in accordance with AAMA 1503.1.

1.2.5 Life Safety Criteria

Windows shall conform to NFPA 101 Life Safety Code when rescue and/or second means of escape are indicated.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-01 Data

Aluminum Windows; FIO.

Manufacturer's descriptive data and catalog cut sheets.

SD-04 Drawings

Aluminum Windows; FIO.

Insect Screens; FIO.

Drawings indicating elevations of window, rough-opening dimensions for each type and size of window, full-size sections, thicknesses of metal, fastenings, methods of installation and anchorage, connections with other work, type of wall construction, size and spacing of anchors, method of glazing, types and locations of operating hardware, mullion details, weatherstripping details, screen details including method of attachment, and window schedules showing locations of each window type.

SD-06 Instructions

Aluminum Windows; FIO.

Manufacturer's preprinted installation instructions and cleaning instructions.

SD-09 Reports

Aluminum Windows; FIO.

Reports for each type of aluminum window attesting that identical windows have been tested and meet all performance requirements established under paragraph WINDOW PERFORMANCE.

SD-13 Certificates

Aluminum Windows; FIO.

Certificates stating that the aluminum windows are AAMA certified conforming to requirements of this section. Labels or markings permanently affixed to the window will be accepted in lieu of certificates.

SD-14 Samples

Aluminum Windows; FIO.

Manufacturer's standard color samples of the specified finishes.

1.4 QUALIFICATION

Window manufacturer shall specialize in designing and manufacturing the type of aluminum windows specified in this section, and shall have a minimum of 5 years of documented successful experience. Manufacturer shall have the facilities capable of meeting contract requirements, single-source responsibility and warranty.

1.5 DELIVERY AND STORAGE

Aluminum windows shall be delivered to project site and stored in accordance with manufacturer's recommendations. Damaged windows shall be replaced with new windows.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 - PRODUCTS

2.1 ALUMINUM WINDOW TYPES

Aluminum windows shall consist of complete units including sash, glass, frame, weatherstripping, and hardware. Windows shall conform to AAMA 101. Windows shall be double-glazed and shall have a minimum condensation resistance factor of 10 when tested in accordance with AAMA 1503.1.

2.1.1 Fixed Windows

Aluminum fixed windows shall conform to AAMA 101 HC50 type, non-operable glazed frame, complete with provisions for reglazing in the field.

2.1.2 Horizontal-Sliding Windows

Aluminum horizontal windows shall conform to AAMA 101 HS HC50 type consisting of sliding sash and fixed lite. Sash guides shall be nylon wheels.

2.2 WEATHERSTRIPPING

Weatherstripping for ventilating sections shall be of type designed to meet water penetration and air infiltration requirements specified in this section in accordance with AAMA 101, and shall be manufactured of material compatible with aluminum and resistant to weather. Weatherstrips shall be factory-applied and easily replaced in the field. Neoprene or polyvinylchloride weatherstripping are not acceptable where exposed to direct sunlight.

2.3 INSECT SCREENS

Insect screens shall be aluminum window manufacturer's standard design, and shall be provided where scheduled on drawings. Insect screens shall be fabricated of roll-formed tubular-shaped aluminum frames conforming to SMA

1004 and (18 x 16) aluminum mesh screening conforming with ISWA IWS 089, Type III.

2.4 ACCESSORIES

2.4.1 Fasteners

Fastening devices shall be window manufacturer's standard design made from aluminum, non-magnetic stainless steel, cadmium-plated steel, nickel/chrome-plated steel or magnetic stainless steel in compliance with AAMA 101. Self-tapping sheet metal screws will not be acceptable for material thicker than 1/16 inch.

2.4.2 Hardware

Hardware shall be as specified for each window type and shall be fabricated of aluminum, stainless steel, cadmium-plated steel, zinc-plated steel or nickel/chrome-plated steel of quality established by AAMA 101.

2.4.3 Window Anchors

Anchoring devices for installing windows shall be made of aluminum, cadmium-plated steel, stainless steel, or zinc-plated steel conforming to AAMA 101.

2.5 GLASS AND GLAZING

Aluminum windows shall be designed for inside glazing, field glazing, and for glass types scheduled on drawings and specified in Section 08810 -GLASS AND GLAZING. Units shall be complete with glass and glazing provisions to meet AAMA 101. Glazing material shall be compatible with aluminum, and shall not require painting.

2.6 FINISH

2.6.1 Anodized Aluminum Finish

Exposed surfaces of aluminum windows shall be finished with anodic coating conforming to AA DAF-45: Architectural Class II, AA-M10-C22-A31, clear anodic coating, 0.010 to 0.02 mm (0.4 to 0.7 mil) thick, 204-R1 Natural Color. Finish shall be free of scratches and other blemishes.

PART 3 - EXECUTION

3.1 INSTALLATION

Aluminum windows shall be installed in accordance with approved shop drawings and manufacturer's published instructions. Aluminum surfaces in contact with masonry, concrete, wood and dissimilar metals other than stainless steel, zinc, cadmium or small areas of white bronze, shall be protected from direct contact using protective materials recommended by AAMA 101. The completed window installation shall be watertight in accordance with Section 07920 - JOINT SEALING. Glass and glazing shall be installed in accordance with requirements of this section and Section 08810 - GLASS AND GLAZING.

3.2 ADJUSTMENTS AND CLEANING

3.2.1 Hardware Adjustments

Final operating adjustments shall be made after glazing work is complete. Operating sash or ventilators shall operate smoothly and shall be weathertight when in locked position.

3.2.2 Cleaning

Aluminum window finish and glass shall be cleaned on exterior and interior sides in accordance with window manufacturer's recommendations. Alkaline or abrasive agents shall not be used. Precautions shall be taken to avoid scratching or marring window finish and glass surfaces.

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SECTION 08700

BUILDERS' HARDWARE

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen
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BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.1	(1988) Butts and Hinges
BHMA A156.2	(1989) Bored and Preamsembled Locks and Latches
BHMA A156.3	(1994) Exit Devices
BHMA A156.4	(1992) Door Controls - Closers
BHMA A156.5	(1992) Auxiliary Locks & Associated Products
BHMA A156.6	(1986) Architectural Door Trim
BHMA A156.7	(1988) Template Hinge Dimensions
BHMA A156.8	(1994) Door Controls - Overhead Holders
BHMA A156.13	(1994) Mortise Locks & Latches
BHMA A156.15	(1986) Closer Holder Release Devices
BHMA A156.16	(1989) Auxiliary Hardware
BHMA A156.18	(1987) Materials and Finishes
BHMA A156.21	(1989) Thresholds

DOOR AND HARDWARE INSTITUTE (DHI)

DHI-02	(1986) Installation Guide for Doors and Hardware
DHI-04	(1976) Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames

DHI-05 (1990) Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames

DHI A115-W (1993) Wood Door Hardware Standards (Incl A115-W1 thru A115-W9)

FEDERAL STANDARDS (FED-STD)

FED-STD 795 (Basic) Uniform Federal Accessibility Standards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (1992) Fire Doors and Windows

NFPA 101 (1994) Safety to Life from Fire in Buildings and Structures

NFPA 105 (1993) Smoke-Control Door Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-01 Data

Hardware and Accessories; FIO.

Manufacturer's descriptive data, technical literature, catalog cuts, and installation instructions. Spare parts data for locksets, exit devices, closers, electric locks, electric strikes, electro-magnetic closer holder release devices, and electric exit devices, after approval of the detail drawings, and not later than 1 month(s) prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

1.3 DELIVERY, STORAGE, AND HANDLING

Hardware shall be delivered to the project site in the manufacturer's original packages. Each article of hardware shall be individually packaged in the manufacturer's standard commercial carton or container, and shall be properly marked or labeled to be readily identifiable with the approved hardware schedule.

1.4 SPECIAL TOOLS

Special tools, such as those supplied by the manufacturer, shall be provided as required to adjust hardware items.

PART 2 - PRODUCTS**2.1 GENERAL HARDWARE REQUIREMENTS**

Hardware shall conform to the requirements specified herein and the HARDWARE SETS listing at the end of this section. Hardware items providing accessibility and usability for physically handicapped shall comply with FED-STD 795.

2.2 TEMPLATES

Templates of hinges shall conform to BHMA A156.7.

2.3 HINGES

Hinges shall conform to BHMA A156.1. Hinges used on metal doors and frames shall also conform to BHMA A156.7.

2.3.1 Contractor's Option

Hinges with antifriction bearings may be furnished in lieu of ball bearing hinges, except where prohibited for fire doors by the requirements of NFPA 80.

2.4 LOCKS AND LATCHES

To the maximum extent possible, locksets, latchsets and deadlocks shall be the products of a single manufacturer. Knob diameter shall be 2-1/8 to 2-1/4 inches.

2.4.1 Mortise Lock and Latchsets

Mortise lock, latchsets, and strikes shall be series 1000 and shall conform to BHMA A156.13, operational Grade 1.

2.4.2 Bored Lock and Latchsets

Bored lock, latchsets, and strikes shall be series 4000 and shall conform to BHMA A156.2, Grade 1.

2.4.3 Auxiliary Locks and Associated Products

Bored and mortise deadlocks and latchsets, narrow style locks, rim locks, and electric strikes shall conform to BHMA A156.5.

2.4.4 Lock Cylinders (Mortise, Rim and Bored)

Lock cylinders shall comply with BHMA A156.5. Lock cylinder shall have not less than six pins. Cylinders shall have key removable type cores. An extension of the existing keying system shall be provided. The existing locks were manufactured by Arrow and have interchangeable cores. Construction interchangeable cores] shall be provided.

2.4.5 Lock Trim

Lock trim shall be cast, forged, or heavy wrought construction of commercial plain design. In addition to meeting the test requirement of BHMA A156.2 or BHMA A156.13, knobs, lever handles, roses, and escutcheons shall be 0.050 inch thick, if unreinforced. If reinforced, the outer shell shall be 0.035 inch thick and the combined thickness shall be 0.070 inch except that knob shanks shall be 0.060 inch thick.

2.5 EXIT DEVICES AND EXIT DEVICE ACCESSORIES

Exit devices and exit device accessories shall conform to BHMA A156.3, Grade 1. Door coordinator with carry bar shall be Type 21 and shall be provided for each pair of doors equipped with an overlapping astragal.

2.6 KEYING

Locks shall be keyed in sets or subsets as scheduled. Change keys for locks shall be stamped with change number and the inscription "U.S. Property - Do Not Duplicate." Keys shall be supplied as follows:

Locks:	2 change keys each lock.
Master keyed sets:	3 keys each set.
Construction keys:	3 total.
Blank keys:	10 total.

The keys shall be furnished to the Contracting Officer arranged for key control system storage in sets or subsets as scheduled.

2.7 DOOR CLOSING DEVICES

Door closing devices shall conform to BHMA A156.4, Grade 1. Closing devices shall be products of one manufacturer for each type specified.

Surface type closers shall be Grade 1, Series C02000 Full Cover Closers for doors close to a wall shall be of narrow projection so as not to strike the wall at the 90-degree open position.

2.8 DOOR CONTROLS - OVERHEAD HOLDERS

Door controls - overhead holders shall conform to BHMA A156.8.

2.9 SMOKE DETECTORS AND MAGNETIC HOLDERS

Smoke detectors and magnetic holders shall conform to Section 16721 - FIRE DETECTION AND ALARM SYSTEM and BHMA A156.15.

2.10 ARCHITECTURAL DOOR TRIM

Architectural door trim shall conform to BHMA A156.6.

2.10.1 Door Protection Plates**2.10.1.1 Kick Plates**

Kick plates shall be Category J100, stainless steel. Width of plates shall be 2 inches less than door width for single doors and 1 inch less for pairs of doors. Height shall be 10 inches, except where the bottom rail is less than 10 inches the plate shall extend to within 1/2 inch of the panel mold or glass bead. Edges of metal plates shall be beveled.

2.10.1.2 Mop Plates

Mop plates shall be Category J100, stainless steel. Width of plates shall be 2 inches less than door width for single doors and 1 inch less for pairs of doors. The height shall be 4 inches. Edges of metal plates shall be beveled.

2.10.2 Combination Push-Pull Plates

Combination push-pull plates shall be Category J300, 0.050 inch thick minimum stainless steel beveled four edges.

2.10.3 Door Pulls and Push/Pull Units**2.10.3.1 Arm Pulls**

Arm pulls shall be Category J400, double base, stainless steel.

2.11 AUXILIARY HARDWARE

Auxiliary hardware, consisting of door holders ,door stops, shall conform to BHMA A156.16.

2.12 MISCELLANEOUS**2.12.1 Automatic Door Bottoms**

Automatic door bottoms shall be semi-mortised type with aluminum housing cover, anodized clear finish.

2.12.2 Metal Thresholds

Thresholds shall conform to BHMA A156.21. Thresholds for exterior doors shall be extruded aluminum of the type indicated and shall provide proper clearance and an effective seal with specified weather stripping. [Air leakage rate of weatherstripping shall not exceed 0.775 L/s per lineal meter (0.5 cubic feet per minute per lineal foot) of crack when tested in accordance with ASTM E 283 at standard test conditions.

2.12.3 Rain Drips

Extruded aluminum, not less than 0.07 inch] thick, [mill finished] painted. Door sill rain drips shall be 1-1/2 inches to 1-3/4 inches] high by 5/8 inch projection. Overhead rain drips shall be approximately 1-1/2 inches high by

2-1/2 inches projection and shall extend 2 inches on either side of the door opening width.

2.12.4 Aluminum Housed Type Weatherseals

Weatherseals of the type indicated shall consist of extruded aluminum retainers not less than 0.07 inch wall thickness with vinyl, neoprene, silicone rubber, polyurethane or vinyl brush inserts. Aluminum shall be clear (natural) anodized. Weatherseal material shall be of an industrial/commercial grade. Air leakage rate of weatherstripping shall not exceed 0.775 L/s per lineal meter (0.5 cubic foot per minute per lineal foot) of crack when tested in accordance with ASTM E 283 at standard test conditions.

2.12.5 Gasketing

Gasketing shall be a compression type seal, silicon based, self-adhesive product for use on steel door frames with steel doors for 20-minute . Color shall be bronze. Air leakage rate of weatherstripping shall not exceed 0.775 L/s per lineal meter (0.5 cubic foot per minute per lineal foot) of crack when tested in accordance with ASTM E 283 at standard test conditions.

2.13 FASTENINGS

Fastenings of proper type, size, quantity, and finish shall be supplied with each article of hardware.

2.14 FINISHES

Unless otherwise specified, finishes shall conform to those identified in BHMA A156.18. Where painting of primed surfaces is required, painting is specified in Section 09900 - PAINTING, GENERAL.

2.15 HARDWARE FOR FIRE DOORS

Hardware for fire doors shall conform to the requirements of NFPA 80 and NFPA 101.

PART 3 - EXECUTION

3.1 APPLICATION

Hardware shall be located in accordance with DHI-04 and DHI-05. When approved, slight variations in locations or dimensions will be permitted. Application shall be in accordance with DHI-02 or DHI A115-W.

3.1.1 Hardware for Fire Doors and Smoke-Control Door Assemblies

Hardware for fire doors shall be installed in accordance with the requirements of NFPA 80. Exit devices installed on fire doors shall have a visible label bearing the marking "Fire Exit Hardware". Hardware for smoke-control door assemblies shall be installed in accordance with NFPA 105.

3.1.2 Key Control Storage Systems

Key control storage system shall be furnished to the Contracting Officer.

3.1.3 Weatherseals

Weatherseals shall be located as indicated, snug to door face and fastened in place with color matched metal screws after door and frames have been finish painted. Screw spacing shall be as recommended by manufacturer.

3.1.4 Gasketing

Gasketing shall be installed at the inside edge of the hinge and head and latch sides of door frame. Frames shall be toleranced for a 1/8 inch clearance between door and frame. Frames shall be treated with tape primer prior to installation.

3.2 OPERATIONAL TESTS

Prior to acceptance of any electrical hardware system, an operational test shall be performed to determine if devices are operating as intended by the specifications. Wiring shall be tested for correct voltage, current carrying capacity, and proper grounding. Stray voltages in lock wiring shall be eliminated to prevent locking devices from releasing in critical situations.

3.3 HARDWARE SETS

HW-1 DOORS # 100, 101

1 1/2 PR	HINGES, A8112 X 630
1 EA	EXIT DEVICE, TYPE 04, FUNCTION 08 X LEVER, GRADE 1 X 630
1 EA	CLOSER, C02061 X 630
1 EA	THRESHOLD, J36193
1 SET	WEATHERSTRIPPING
1 EA	DOOR BOTTOM, PEMKO 222D, OR EQUAL
1 SET	RAIN DRIP
1 SETS	SILENCERS

HW-2 DOOR #102, 103, 107, 109 (POCKET DOORS)

1 SET	POCKET DOOR TRACK HARDWARE, D8011
1 EA	EDGE PULL, D2801, HEAVY DUTTY

HW-3 DOORS #106, 110, 111, 112, 115, 118, 121

1 1/2 PR	HINGES, A8112 X 630
1 EA	LOCKSET, F07, LEVER
1 EA	CLOSER, C02021, WITH STOP AT CLOSER
1 EA	SILENCERS
1 EA	KICKPLATE

HW-4 DOORS #104, 105, 114 (SECURITY GRADE HARDWARE), 117, 119, 120

1 1/2 PR	HINGES, A8112 X 630
1 EA	LOCKSET F05, LEVER
1 EA	CLOSER, C02021
1 EA	STOP, 102181
1 SET	SILENCERS

HW-5 DOOR #116

1 1/2 PR	HINGES, A8112
1 EA	LOCKSET, F02, LEVER
1 EA	CLOSER, C02011
1 EA	DOOR STOP, L02141
1 SET	SILENSERS
1 EA	KICK PLATE, J102

HW-6 DOOR #108, 113 (SECURITY)

1 1/2 PR	HINGES
1 EA	LOCKSET, F18
1 EA	CLOSER, WITH STOP
1 SET	SILENCERS
2 EA	KICKPLATE

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SECTION 08810

GLASS AND GLAZING

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(1984; R 1994) Safety Performance Specifications and Methods of Test for Safety Glazing Materials in Buildings
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509	(1994) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 669	(1995) Glazing Compounds for Back Bedding and Face Glazing of Metal Sash
ASTM C 864	(1993) Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
ASTM C 920	(1994) Elastomeric Joint Sealants
ASTM C 1036	(1991) Flat Glass
ASTM C 1048	(1992) Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
ASTM C 1172	(1991) Laminated Architectural Flat Glass
ASTM C 1349	(1996) Architectural Flat Glass Clad Polycarbonate
ASTM D 395	(1989; R 1994) Rubber Property - Compression Set
ASTM E 119	(1995a) Fire Tests of Building Construction and Materials
ASTM E 773	(1988) Seal Durability of Sealed Insulating Glass Units
ASTM E 774	(1992) Sealed Insulating Glass Units
ASTM E 1300	(1994) Determining the Minimum Thickness and Type of Glass Required to Resist a Specified Load

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 (1995) Minimum Design Loads for Buildings and Other Structures

CODE OF FEDERAL REGULATIONS (CFR)

16 CFR 1201 Safety Standard for Architectural Glazing Materials

COMMERCIAL ITEM DESCRIPTION (CID)

CID A-A-378 (Basic) Putty: Linseed Oil Type, (for Wood-Sash-Glazing)

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA-01 (1990) Glazing Manual

GANA-04 (1995) Engineering Standards Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (1995) Fire Doors and Windows

NFPA 252 (1995) Fire Tests of Door Assemblies

NFPA 257 (1996) Fire Tests for Window and Glass Block Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-01 Data

Glass; FIO.

Glazing Accessories; FIO.

Manufacturer's descriptive product data, handling and storage recommendations, installation instructions, and cleaning instructions.

SD-04 Drawings

Glazing Materials and Accessories; FIO.

Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of glass.

SD-13 Certificates

Glass; FIO.

Certificates stating that the glass meets the specified requirements. Labels or manufacturers marking affixed to the glass will be accepted in lieu of certificates.

1.3 SYSTEM DESCRIPTION

Glazing systems shall be fabricated and installed watertight and airtight to withstand thermal movement and wind loading without glass breakage, gasket failure, deterioration of glazing accessories, and defects in the work. Glazed panels shall comply with the safety standards, as indicated in accordance with ANSI Z97.1. Glazed panels shall comply with indicated wind/snow loading in accordance with ASTM E 1300.

1.4 DELIVERY, STORAGE AND HANDLING

Glazing compounds shall be delivered to the site in the manufacturer's unopened containers. Glass shall be stored indoors in a safe, well ventilated dry location in accordance with manufacturer's instructions, and shall not be unpacked until needed for installation. Glass shall not be stored on site over 1 month.

1.5 PROJECT/SITE CONDITIONS

Glazing work shall not be started until outdoor temperature is above 5 degrees C (40 degrees F) and rising, unless procedures recommended by glass manufacturer and approved by Contracting Officer are made to warm the glass and rabbet surfaces. Ventilation shall be provided to prevent condensation of moisture on glazing work during installation. Glazing work shall not be performed during damp or raining weather.

1.6 WARRANTY

1.6.1 Insulating Glass

Manufacturer shall warrant the insulating glass to be free of fogging or film formation on the internal glass surfaces caused by failure of the hermetic seal for a period of 10 years from Date of Substantial Completion. Warranty shall be signed by manufacturer.

1.6.2 Monolithic Reflective Glass

Manufacturer shall warrant the monolithic reflective glass to be free of peeling or deteriorating of coating for a period of 10 years after Date of Substantial Completion. Warranty shall be signed by manufacturer.

PART 2 - PRODUCTS

2.1 FLOAT GLASS

2.1.1 Annealed Glass

Annealed glass shall be Type I transparent flat type, Class 1 - tinted, Quality q3 - glazing select, 45 percent light transmittance, conforming to ASTM C 1036. Color shall be bronze.

2.1.2 Tinted (Light-Reducing) Glass

Tinted (light-reducing) glass shall be Type I transparent flat type, Class 3-tinted, Quality q3 - glazing select, 45 percent light transmittance, conforming to ASTM C 1036. Color shall be bronze.

2.2 ROLLED GLASS

2.3 INSULATING GLASS

Insulating glass shall be Class A preassembled units of dual-seal construction consisting of lites of glass separated by an aluminum spacer and dehydrated space conforming to ASTM E 773 and ASTM E 774. Aluminum spacer shall be roll-formed, with bent or tightly soldered joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone. Glass types shall be as follows:

2.3.1 Clear Insulating Glass

Glass for two-pane insulating units shall be Type I annealed glass, Class 1 - clear, Quality q3 - glazing select, conforming to ASTM C 1036.

2.3.2 Low-E Insulating Glass

Interior and exterior glass panes for Low-E insulating units shall be Type I annealed flat glass, Class 2-tinted with anti-reflective low-emissivity coating on No. 2 surface (inside surface of exterior pane), Quality q3 - glazing select, conforming to ASTM C 1036. Color shall be bronze.

2.4 GLAZING ACCESSORIES

2.4.1 Preformed Tape

Preformed tape shall be elastomeric rubber extruded into a ribbon of a width and thickness suitable for specific application. Tape shall be of type which will remain resilient, have excellent adhesion, and be chemically compatible to glass, metal, or wood.

2.4.2 Sealant

Sealant shall be elastomeric conforming to ASTM C 920, Type S or M, Grade NS, Class 12.5, Use G, of type chemically compatible with setting blocks, preformed sealing tape and sealants used in manufacturing insulating glass. Color of sealant shall be as selected.

2.4.3 Glazing Gaskets

Glazing gaskets shall be extruded with continuous integral locking projection designed to engage into metal glass holding members to provide a watertight seal during dynamic loading, building movements and thermal movements. Glazing gaskets for a single glazed opening shall be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets shall be in lengths or units recommended by manufacturer to ensure against pull-back at corners. Glazing gasket profiles shall be as indicated on drawings.

2.4.3.1 Fixed Glazing Gaskets

Fixed glazing gaskets shall be closed-cell (sponge) smooth extruded compression gaskets of cured elastomeric virgin neoprene compounds conforming to ASTM C 509, Type 2, Option 1.

2.4.3.2 Wedge Glazing Gaskets

Wedge glazing gaskets shall be high-quality extrusions of cured elastomeric virgin neoprene compounds, ozone resistant, conforming to ASTM C 864, Option 1, Shore A durometer between 65 and 75.

2.4.3.3 Aluminum Framing Glazing Gaskets

Glazing gaskets for aluminum framing shall be permanent, elastic, non-shrinking, non-migrating, watertight and weathertight.

2.4.4 Putty and Glazing Compound

Glazing compound shall conform to ASTM C 669 for face-glazing metal sash. Putty shall be linseed oil type conforming to CID A-A-378 for face-glazing primed wood sash. Putty and glazing compounds shall not be used with insulating glass or laminated glass.

2.4.5 Setting and Edge Blocking

Neoprene setting blocks shall be dense extruded type conforming to ASTM D 395, Method B, Shore A durometer between 70 and 90. Edge blocking shall be Shore A durometer of 50 (+ or - 5). Silicone setting blocks shall be required when blocks are in contact with silicone sealant. Profiles, lengths and locations shall be as required and recommended in writing by glass manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

Openings and framing systems scheduled to receive glass shall be examined for compliance with approved shop drawings, GANA-01 and glass manufacturer's recommendations including size, squareness, offsets at corners, presence and function of weep system, face and edge clearance requirements and effective sealing between joints of glass-framing members. Detrimental materials shall be removed from glazing rabbet and glass surfaces and wiped dry with solvent. Glazing surfaces shall be dry and free of frost.

3.2 INSTALLATION

Glass and glazing work shall be performed in accordance with approved shop drawings, GANA-01, glass manufacturer's instructions and warranty requirements. Glass shall be installed with factory labels intact and removed only when instructed. Wired glass and fire/safety rated glass shall be installed in accordance with NFPA 80. Edges and corners shall not be ground, nipped or cut after leaving factory. Springing, forcing or twisting of units during installation will not be permitted.

3.3 CLEANING

Upon completion of project, outside surfaces of glass shall be washed clean and the inside surfaces of glass shall be washed and polished in accordance with glass manufacturer's recommendations.

3.4 PROTECTION

Glass work shall be protected immediately after installation. Glazed openings shall be identified with suitable warning tapes, cloth or paper flags, attached with non-staining adhesives. Reflective glass shall be protected with a protective material to eliminate any contamination of the reflective coating. Protective material shall be placed far enough away from the coated glass to allow air to circulate to reduce heat buildup and moisture accumulation on the glass. Glass units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities shall be removed and replaced with new units.

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SECTION 09250

GYPSUM WALLBOARD

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 580	(1994) Stainless and Heat Resisting Steel Wire
ASTM A 853	(1993) Steel Wire, Carbon, for General Use
ASTM C 36	(1994) Gypsum Wallboard
ASTM C 79	(1994) Gypsum Sheathing Board
ASTM C 442	(1992) Gypsum Backing Board and Coreboard
ASTM C 475	(1993) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C 514	(1994) Nails for the Application of Gypsum Board
ASTM C 557	(1993a) Adhesive for Fastening Gypsum Wallboard to Wood Framing
ASTM C 630	(1993) Water-Resistant Gypsum Backing Board
ASTM C 645	(1994) Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board
ASTM C 754	(1988) Installation of Steel Framing Members to Receive Screw-Attached Gypsum
ASTM C 840	(1994) Application and Finishing of Gypsum Board
ASTM C 931	(1992) Exterior Gypsum Soffit Board
ASTM C 955	(1994) Load-Bearing (Transverse and Axial) Steel Studs, Runners (Track), and Bracing or Bridging for Screw Application of Gypsum Board and Metal Plaster Bases
ASTM C 960	(1991) Predecorated Gypsum Board
ASTM C 1002	(1993) Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P8016 (1994) Specification Tested Products Guide

FEDERAL SPECIFICATIONS (FS)

FS QQ-N-281 (Rev D; Am 2) Nickel-Copper Alloy Bar, Rod, Plate, Sheet, Strip, Wire, Forgings and Structural and Special Shaped Sections

GYPSUM ASSOCIATION (GA)

GA 600 (1994) Fire Resistance Design Manual

UNDERWRITERS LABORATORIES (UL)

UL-05 (1994; suppl) Fire Resistance Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-04 Drawings

Steel Framing; FIO.

Control Joints; FIO.

Fire-Resistant Assemblies; FIO.

Drawings and installation details for ceiling framing, furring, special wall framing, and framed openings in walls and ceilings.

SD-13 Certificates

Gypsum Wallboard; FIO.

Water-Resistant Gypsum Board; FIO.

Exterior Gypsum Soffit Board; FIO.

Steel Framing; FIO.

Certificates stating that the steel framing and gypsum wallboard meet the specified requirements.

1.3 DELIVERY, STORAGE AND HANDLING

Materials shall be delivered in original containers bearing the name of manufacturer, contents, and brand name. Materials shall be stored in accordance with manufacturer's printed instructions.

1.4 ENVIRONMENTAL CONDITIONS

Environmental conditions for application and finishing of gypsum board shall be in accordance with ASTM C 840.

PART 2 - MATERIALS

2.1 NON-LOADBEARING STUD WALLS

2.1.1 Studs

Studs for non-loadbearing walls shall conform to ASTM C 645. Studs shall be 18 gauge steel, C-shaped, punched web for utility access, G60 hot-dip galvanized, or truss-designed studs fabricated of 16 gauge steel angles with a single No. 7 gauge rod forming an open-web truss.

2.1.2 Runner Tracks

Floor and ceiling runner tracks shall conform to ASTM C 645. Tracks shall be, U-shaped with minimum 7/8 inch flanges, unpunched web, gauge to match studs, G60 hot-dip galvanized.

2.2 GYPSUM BOARD

Gypsum board shall have square-cut ends, tapered or beveled edges and shall be maximum possible length.

2.2.1 Standard Gypsum Board

Regular gypsum board shall conform to ASTM C 36, and shall be 48 inches wide.

2.2.2 Fire-Rated Gypsum Board

Fire-rated gypsum board shall conform to ASTM C 36, and shall be Type X, 48 inches wide.

2.2.3 Water-Resistant Gypsum Board

Water-resistant gypsum board shall conform to ASTM C 630, regular, and shall be 48 inch width.

2.2.4 Gypsum Backing Board

Gypsum backing board shall conform to ASTM C 442, regular, 48 inches wide. Backing board shall have aluminum foil vapor retarder laminated to back surface.

2.3 ACCESSORIES

2.3.1 Taping and Embedding Compound

Taping and embedding compound shall conform to ASTM C 475.

2.3.2 Finishing or Topping Compound

Finishing or topping compound shall conform to ASTM C 475.

2.3.3 All-Purpose Compound

All-purpose compound shall be compatible with tape and substrate.

2.3.4 Joint Tape

Joint tape shall conform to ASTM C 475 and shall be as recommended by gypsum board manufacturer.

2.3.5 Nails

Nails shall conform to ASTM C 514.

2.3.6 Screws

Screws shall conform to ASTM C 1002. Screws shall be, Type G for gypsum board to gypsum board.

2.3.7 Adhesives

Adhesives shall conform to ASTM C 557.

2.3.8 Hangers

Suspended ceiling runner channel hangers shall be soft, annealed steel wire not less than 0.1620 inch nominal diameter, conforming to ASTM A 853 or flat iron or steel straps, at least 3/32 by 7/8 inch size, coated with zinc, cadmium, or rust-inhibiting paint.

2.3.9 Fastenings

Tie wire, clips, rings, and other fastenings shall be corrosion-resisting steel conforming to ASTM A 580, composition 302, 304, or 316, Condition A, or nickel-copper alloy conforming to FS QQ-N-281, Class A or B, annealed condition except vertical surfaces not incorporated in ceiling construction may be erected with soft, annealed steel conforming to ASTM A 853.

PART 3 - EXECUTION**3.1 INTERIOR WALL FRAMING**

Steel framing and furring members shall be installed in accordance with ASTM C 754.

3.2 SUSPENDED CEILING FRAMING

Suspended ceiling system framing shall be installed in accordance with ASTM C 754.

3.3 APPLICATION OF GYPSUM BOARD

Gypsum board shall be installed in accordance with ASTM C 840 and as specified.

3.4 TAPING AND FINISHING

Gypsum board taping and finishing shall be performed in accordance with ASTM C 840.

3.5 FIRE-RESISTANT ASSEMBLIES

Gypsum wallboard for fire-rated assemblies shall be in accordance with UL-05, FM P8016 or GA 600 for the design number indicated on drawings.

3.6 PATCHING

Surface defects and damage shall be corrected as required to leave gypsum board ready to receive finish as specified.

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SECTION 09510 - ACOUSTICAL CEILINGS

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 635	(1994) Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C 636	(1992) Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM E 119	(1988) Fire Tests of Building Construction and Materials
ASTM E 1264	(1990) Standard Classification for Acoustical Ceiling Products

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-01 Data

Acoustical Ceiling System; FIO.

Manufacturer's descriptive data and installation instructions.

SD-14 Samples

Acoustical Units; FIO.

Suspension System; FIO.

Two samples of each type of acoustical unit and suspension grid tee section showing texture, finish, and color.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Materials shall be stored in accordance with manufacturers recommendations.

1.4 ENVIRONMENTAL REQUIREMENTS

A uniform temperature of not less than 60 degrees F nor more than 80 degrees F and a relative humidity of not more than 70 percent shall be maintained before, during, and after installation of acoustical units.

PART 2 - PRODUCTS

2.1 ACOUSTICAL UNITS

Acoustical units shall conform to ASTM E 1264, Class A, and the following requirements:

2.1.1 Units for Exposed-Grid System

Type: III, Form 2, Pattern C E
NRC grade: 55 minimum when tested on mounting No. 7.
Pattern: Georgian as manufactured by Armstrong or approved equal
Nominal size: 24 by 48 inches.
Edge detail: Square lay-in .
Finish: Factory-applied standard finish.
LR grade: .83
CAC: 33

2.2 SUSPENSION SYSTEM

Suspension system shall be exposed-grid and shall conform to ASTM C 635 for intermediate-duty systems. Surfaces exposed to view shall be aluminum or steel with a factory-applied white baked-enamel finish. Wall molding shall have a flange of not less than 15/16 inch and shall be provided with outside corner caps. Inside corner caps shall be provided where needed to produce a workmanlike appearance.

2.3 HANGERS

Hangers shall be galvanized steel wire. Hangers and attachment shall support a minimum 300 pound ultimate load without failure.

2.4 ACCESS PANELS

Access panels shall match adjacent acoustical units and shall have suitable framing and fastenings for removal and replacement without damage. Panel shall be not less than 12 by 12 inches or more than 12 by 24 inches. An identification plate of 0.032 inch thick aluminum, 3/4 inch in diameter, stamped with the letters "AP" and finished the same as the unit, shall be attached near one corner on the face of each access panel.

2.5 FINISHES

Acoustical units and suspension system members shall have manufacturer's standard textures, patterns and finishes as specified. Ceiling suspension system components shall be treated to inhibit corrosion.

2.6 COLORS AND PATTERNS

Colors and patterns for acoustical units and suspension system components shall be indicated in the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

Acoustical work shall be provided complete with necessary fastenings, clips, and other accessories required for a complete installation. Suspension system shall be installed in accordance with ASTM C 636 and as specified herein. There shall be no hanger wires or other loads suspended from underside of steel decking. Acoustical units shall be installed in accordance with the approved installation instructions of the manufacturer. Acoustical units shall be arranged so that units less than one-half width are minimized. Units in exposed-grid system shall be held in place with manufacturer's standard hold-down clips, if units weigh less than 1 psf or if required for fire resistance rating.

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SECTION 09650 - RESILIENT FLOORING

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM F 1066 (1987) Vinyl Composition Floor tile

FEDERAL SPECIFICATIONS (FS)

FS L-F-475 (Rev A; Am 1; Int Am 3) Floor Covering Vinyl, Surface (Tile and Roll), with Backing

FS SS-W-40 (Rev A; Int Am 1; Notice 1) Wall Base: Rubber, and Vinyl Plastic

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-01 Data

Resilient Flooring and Accessories; FIO.

Manufacturer's descriptive data and installation instructions. Cleaning and maintenance instructions shall be included.

SD-14 Samples

Resilient Flooring and Accessories; FIO.

Three samples of each indicated color and type of flooring an base. Sample size shall be minimum 3 inches by 5 inches.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the building site in original unopened containers and shall be stored according to manufacturer's recommendations.

1.4 ENVIRONMENTAL REQUIREMENTS

Areas to receive resilient flooring shall be maintained at a temperature above 70 degrees F for 2 days before application, during application and 2 days after application. A minimum temperature of 55 degrees F shall be maintained thereafter.

1.5 SCHEDULING

Resilient flooring application shall be scheduled after the completion of other work which would damage the finished surface of the flooring.

PART 2 - PRODUCTS**2.1 VINYL-COMPOSITION TILE**

Vinyl-composition tile shall conform to ASTM F 1066, Class 2, (through pattern tile), Composition 1, asbestos-free, and shall be 12 inches square and 1/8 inch thick. Tile shall have the color and pattern uniformly distributed throughout the thickness of the tile. Flooring in any one continuous area shall be from the same lot and shall have the same shade and pattern.

2.2 SOLID VINYL TILE

Solid vinyl tile shall conform to FS SS-T-312 Type III. Tile shall be 12 inches square by 1/8 inch thick. Tiles shall be of solid unlaminated construction.

2.3 RESILIENT BASE

Base shall conform to FS SS-W-40, Type I (rubber) or Type II (vinyl). Style B, (coved)-installed with resilient flooring. Butt toe (cove)-installed with 1/8 inch thick flooring. Base shall be 4 inches high minimum 1/8 inch thick. Preformed outside corners shall be furnished.

2.4 EDGE STRIP

Edge strip shall be vinyl, 1 inch wide, and of thickness to match the flooring.

2.5 ADHESIVE

Adhesive for flooring and wall base shall be as recommended by the flooring manufacturer.

2.6 COLOR

Color shall be as indicated in the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

Flooring and accessories shall be installed in accordance with manufacturer's instructions.

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SECTION 09900

PAINTING, GENERAL

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH-02	(1996) Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 150	(1995) Portland Cement
ASTM D 3273	(1994) Resistance to Growth of Mold on the Surface of Interior Coating in an Environmental Chamber
ASTM D 3274	(1995) Evaluating Degree of Surface Disfigurement of Paint Films by Microbial (Fungal or Algal) Growth or Soil and Dirt Accumulation
ASTM D 4214	(1989) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4258	(1983; R 1992) Surface Cleaning Concrete for Coating

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1500	(Rev A) Sealer, Surface (Latex Block Filler)
CID A-A-2246	(Rev A) Paint, Latex (Gloss, Interior)
CID A-A-2247	(Basic) Paint, Latex (Semigloss, Interior)
CID A-A-2248	(Basic) Paint, Latex, (Flat, Interior)
CID A-A-2336	(Basic) Primer Coating (Oil-Alkyd, Exterior Wood, White and Tints)
CID A-A-2340	(Basic) Primer Coating (Latex, White, for Gypsum Wallboard)

FEDERAL SPECIFICATIONS (FS)

FS TT-C-555	(Rev B; Am 1) Coating, Textured (for Interior and Exterior Masonry Surfaces)
FS TT-E-489	(Rev J) Enamel, Alkyd, Gloss, Low VOC Content
FS TT-E-2784	(Rev A; Am 1) Enamel (Acrylic-Emulsion, Exterior Gloss and Semigloss)
FS TT-P-19	(Rev D) Paint, Latex (Acrylic Emulsion, Exterior Wood and Masonry)
FS TT-P-645	(Rev B) Primer, Paint, Zinc-Molybdate, Alkyd Type
FS TT-S-223	(Rev B; Notice 2) Sealer, Surface, Floor, Water Emulsion Type

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 20	(1991) Zinc-Rich Primers (Type I - Inorganic and Type II - Organic)
SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (without Lead and Chromate Pigments)
SSPC Paint 26	(1991) Slow Drying Linseed Oil Black Maintenance Primer (Without Lead and Chromate Pigments)
SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 2	(1995) Hand Tool Cleaning
SSPC SP 3	(1995) Power Tool Cleaning
SSPC SP 6	(1994) Commercial Blast Cleaning
SSPC SP 7	(1994) Brush-Off Blast Cleaning

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-01 Data

Paint; FIO.

The names, quantity represented, and intended use for the proprietary brands of materials proposed to be substituted for the specified materials regardless of quantities in states where VOC content limitations apply.

SD-06 Instructions

Mixing and Thinning; FIO.

Application; FIO.

Manufacturer's current printed product description, material safety data sheets (MSDS) and technical data sheets for each coating system. Detailed mixing, thinning and application instructions, minimum and maximum application temperature, and curing and drying times between coats for epoxy, moisture-curing polyurethane, and liquid glaze coatings. Detailed application instructions for textured coatings shall be provided.

SD-09 Reports

Paint; FIO.

A statement as to the quantity represented and the intended use, plus the following test report for batches in excess of 50 gallons:

a. A test report showing that the proposed batch to be used meets all specification requirements, or:

b. A test report showing that a previous batch of the same formulation as the batch to be used met all specification requirements, plus, on the proposed batch to be used, a report of test results for properties of weight per gallon, viscosity, fineness of grind, drying time, color, and gloss.

SD-13 Certificates

Lead; FIO.

Mildewcide and Insecticide; FIO.

Volatile Organic Compound (VOC) Content; FIO.

Certificate stating that paints for interior use contain no mercurial mildewcide or insecticide. Certificate stating that paints proposed for use contain not more than 0.06 percent lead by weight of the total nonvolatile. Certificate stating that paints proposed for use meet Federal VOC regulations and those of the of the local Air Pollution Control Districts having jurisdiction over the geographical area in which the project is located.

SD-14 Samples

Paint; FIO.

While the material is at the site or source of supply, and at a time agreeable to the Contractor and the Contracting Officer, a 1 quart sample of each color and batch, shall be taken by random selection from the sealed containers by the Contractor in the presence of a representative of the Contracting Officer. The contents of the containers to be sampled shall be thoroughly mixed to ensure that the sample is representative. Samples shall be identified by designated name, specification number, manufacturer name and address, batch number, project contract number, intended use, and quantity involved.

1.3 PACKAGING, LABELING, AND STORING

Paints shall be in sealed containers that legibly show the designated name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinner shall be stored in accordance with the manufacturer's written directions and as a minimum stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors and at temperatures between 40 and 95 degrees F. Paints shall be stored on the project site or segregated at the source of supply sufficiently in advance of need to allow 30 days for testing.

1.4 APPROVAL OF MATERIALS

When samples are tested, approval of materials will be based on tests of the samples; otherwise, materials will be approved based on test reports furnished with them. If materials are approved based on test reports furnished, samples will be retained by the Government for testing should the materials appear defective during or after application. In addition to any other remedies under the contract the cost of retesting defective materials will be at the Contractor's expense.

1.5 ENVIRONMENTAL CONDITIONS

Unless otherwise recommended by the paint manufacturer, the ambient temperature shall be between 45 and 95 degrees F when applying coatings other than water-thinned, epoxy, and moisture-curing polyurethane coatings. Water-thinned coatings shall be applied only when ambient temperature is between 50 and 90 degrees F. Epoxy, and moisture-curing polyurethane coatings shall be applied only within the minimum and maximum temperatures recommended by the coating manufacturer. Moisture-curing polyurethane shall not be applied when the relative humidity is below 30 percent.

1.6 SAFETY AND HEALTH

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in the CONTRACT CLAUSES. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.6.1 Worker Exposures

Exposure of workers to hazardous chemical substances shall not exceed limits as established by ACGIH-02, or as required by a more stringent applicable regulation.

1.6.2 Toxic Compounds

Toxic products having ineffective physiological warning properties, such as no or low odor or irritation levels, shall not be used unless approved by the Contracting Officer.

1.6.3 Training

Workers having access to an affected work area shall be informed of the contents of the applicable material data safety sheets (MSDS) and shall be informed of potential health and safety hazard and protective controls associated with materials used on the project. An affected work area is one which may receive mists and odors from the painting operations. Workers involved in preparation, painting and clean-up shall be trained in the safe handling and application, and the exposure limit, for each material which the worker will use in the project. Personnel having a need to use respirators and masks shall be instructed in the use and maintenance of such equipment.

1.6.4 Coordination

Work shall be coordinated to minimize exposure of building occupants, other Contractor personnel, and visitors to mists and odors from preparation, painting and clean-up operations.

PART 2 - PRODUCTS

2.1 PAINT

The term "paint" as used herein includes emulsions, enamels, paints, stains, varnishes, sealers, cement-emulsion filler, and other coatings, whether used as prime, intermediate, or finish coat. Paint shall conform to the respective specifications listed for use in the painting schedules at the end of this section, except when the required amount of a material of a particular batch is 50 gallons or less, an approved first-line proprietary paint material with similar intended formulation, usage and color to that specified may be used. Additional requirements are as follows:

2.1.1 Colors and Tints

Colors shall be as selected from manufacturer's standard colors, as indicated. Manufacturer's standard color is for identification of color only. Tinting of epoxy and urethane paints shall be done by the manufacturer. Stains shall conform in shade to manufacturer's standard color. The color of the undercoats shall vary slightly from the color of the next coat.

2.1.2 Mildewcide and Insecticide

Paint specified for all coats applied to fabrics and vapor barrier jackets over insulation and surfaces in lab and holding areas shall contain a mildewcide that will not adversely affect the color, texture, or durability of the coating. The mildewcide shall be incorporated into the paint by the manufacturer and shall attain a surface disfigurement rating of 8 or greater when tested in accordance with ASTM D 3273 and evaluated in accordance with ASTM D 3274. Mercurial mildewcide shall not be used in interior paint. Insecticides shall not be used in paint.

2.1.3 Lead

Paints containing lead in excess of 0.06 percent by weight of the total nonvolatile content (calculated as lead metal) shall not be used.

2.1.4 Chromium

Paints containing zinc chromate or strontium chromate pigments shall not be used.

2.1.5 Volatile Organic Compound (VOC) Content

Paints shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards and shall conform to the restrictions of the local air pollution control authority.

PART 3 - EXECUTION

3.1 PROTECTION OF AREAS NOT TO BE PAINTED

Items not to be painted which are in contact with or adjacent to painted surfaces shall be removed or protected prior to surface preparation and painting operations. Items removed prior to painting shall be replaced when painting is completed. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Surfaces contaminated by coating materials shall be restored to original condition.

3.2 SURFACE PREPARATION

Surfaces to be painted shall be clean and free of foreign matter before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.2.1 Concrete and Masonry Surfaces

Concrete and masonry surfaces shall be allowed to dry at least 30 days before painting, except concrete slab on grade which shall be allowed to cure 90 days before painting. Surfaces shall be cleaned in accordance with ASTM D 4258. Glaze, efflorescence, laitance, dirt, grease, oil, asphalt, surface deposits of free iron and other foreign matter shall be removed prior to painting. Surfaces to receive polyurethane or epoxy coatings shall be acid-etched or mechanically abraded as specified by the coating manufacturer, rinsed with water, allowed to dry, and treated with the manufacturer's recommended conditioner prior to application of the first coat.

3.2.2 Ferrous Surfaces

Ferrous surfaces including those that have been shop-coated, shall be solvent-cleaned or detergent-washed in accordance with SSPC SP 1. Surfaces that contain loose rust, loose mill scale, and other foreign substances shall be cleaned mechanically with hand tools according to SSPC SP 2, power tools according to SSPC SP 3 or by sandblasting according to SSPC SP 7. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

3.2.3 Nonferrous Metallic Surfaces

Galvanized, aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces shall be solvent-cleaned or detergent-washed in accordance with SSPC SP 1.

3.2.4 Gypsum Board Surfaces

Gypsum board surfaces shall be dry and shall have all loose dirt and dust removed by brushing with a soft brush, rubbing with a cloth, or vacuum-cleaning prior to application of the first-coat material. A damp cloth or sponge may be used if paint will be water-based.

3.2.5 Mastic-Type Surfaces

Mastic-type surfaces shall be prepared by removing foreign material.

3.2.6 Plaster Surfaces

Plaster shall age at least 30 days before painting. Plaster shall be clean and free from loose matter and shall have an instrument-measured moisture content not exceeding 8 percent.

3.2.7 Wood Surfaces

Wood surfaces shall be cleaned of foreign matter. Moisture content of the wood shall not exceed 12 percent as measured by a moisture meter, unless otherwise authorized. Wood surfaces adjacent to surfaces to receive water-thinned paints shall be primed and/or touched up before applying water-thinned paints. Small, dry seasoned knots shall be scraped, cleaned, and given a thin coat of commercial knot sealer, before application of the priming coat. Pitch on large, open, unseasoned knots and all other beads or streaks of pitch shall be scraped off, or, if it is still soft, removed with mineral spirits or turpentine, and the resinous area shall be thinly coated with knot sealer. Finishing nails shall be set, and all holes and surface imperfections shall be primed. After priming, holes and imperfections in finish surfaces shall be filled with putty or plastic wood filler, colored to match the finish coat if natural finish is required, allowed to dry, and sanded smooth. Putty or wood filler shall be compatible with subsequent coatings.

3.2.8 Previously Painted Surfaces

Previously painted surfaces shall be thoroughly cleaned of all grease, dirt, dust or other foreign matter. Blistering, cracking, flaking and peeling or other deteriorated coatings shall be removed. Slick surfaces shall be roughened. Damaged areas such as, but not limited to, nail holes, cracks, chips, and spalls shall be repaired with suitable material to match adjacent undamaged areas. Edges of chipped paint shall be feather edged and sanded smooth. Rusty metal surfaces shall be cleaned as per SSPC requirements. Solvent, mechanical, or chemical cleaning methods shall be used to provide surfaces suitable for painting. Chalk shall be removed so that when tested in accordance with ASTM D 4214, the chalk resistance rating is no less than 8. New, proposed coatings shall be compatible with existing coatings. If existing surfaces are glossy, the gloss shall be reduced.

3.3 MIXING AND THINNING

When thinning is approved as necessary to suit surface, temperature, weather conditions, or application methods, paints may be thinned in accordance with the manufacturer's directions. When thinning is allowed, paints shall be thinned immediately prior to application with not more than 1 pint of suitable thinner per gallon. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

3.3.1 Cement-Emulsion Filler Coat

Cement and aggregate shall be dry-mixed so that uniform distribution and intermixing are obtained. Mixing liquid and one-half of the total amount of water shall be premixed and added gradually to the white portland cement and aggregate with constant stirring until a thick, smooth material is obtained. Emulsion paint shall then be added to the mixture and stirred until uniformity is obtained. The blend shall have a thick, creamy consistency. The remainder of the water shall be added if necessary to obtain a material with adequate application properties. Blending resin emulsion or emulsion paint with any other component shall be done with caution; too rapid an agitation will cause air entrapment and foaming.

3.3.2 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

3.4 APPLICATION

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application. Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces. Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

3.4.1 Ventilation

Affected areas shall be ventilated during paint application so that workers exposure to chemical substances shall not exceed limits as established by ACGIH-02, or as required by a more stringent applicable regulation. Interior work zones having a volume of 10,000 cubic feet or less shall be ventilated at

a minimum of 2 air exchanges per hour. Ventilation in larger work zones shall be maintained by means of mechanical exhaust. Solvent vapors shall be exhausted outdoors, away from air intakes and workers. Return air inlets in the work zone shall be temporarily sealed before start of work until the coatings have dried.

3.4.2 Respirators

Operators and personnel in the vicinity of operating paint sprayers shall wear respirators.

3.4.3 First Coat

The first coat on plaster, gypsum wallboard, and other surfaces shall include repeated touching up of suction spots or overall application of primer or sealer to produce uniform color and gloss. Excess sealer shall be wiped off after each application. The first coat on both faces of wood doors shall be applied at essentially the same time. Glazed doors and sashes shall be given the specified coating system within 3 weeks of the time they are glazed, but not before the glazing material has set; paint shall overlay glass about 70 mils all around. Each varnish coat shall be sanded lightly prior to application of subsequent coats.

3.4.4 Timing

Surfaces that have been cleaned, pretreated, and otherwise prepared for painting shall be given a coat of the specified first coat as soon as practical after such pretreatment has been completed, but prior to any deterioration of the prepared surface. Sufficient time shall elapse between successive coats to permit proper drying. This period shall be modified as necessary to suit weather conditions. Oil-based or oleoresinous solvent-type paints shall be considered dry for recoating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and the application of another coat of paint does not cause the undercoat to lift or lose adhesion. Manufacturer's instructions for application, curing and drying time between coats of two-component systems shall be followed.

3.4.5 Fillers

Concrete and masonry surface voids shall be filled; however, surface irregularities need not be completely filled. The dried filler shall be uniform and free of pinholes. Filler shall not be applied over caulking compound.

3.4.5.1 Cement-Emulsion Filler

Immediately before filler application, surfaces shall be dampened uniformly and thoroughly, with no free surface water visible, by several applications of potable water with a fog spray, allowing time between the sprayings for water to be absorbed. Cement-emulsion filler shall be scrubbed into the surface vigorously with a stiff-bristled brush having tampico or palmyra bristles not longer than 2-1/2 inches. At least 24 hours shall elapse before applying exterior emulsion paint over cement-emulsion filler. When the ambient temperature is over 85 degrees F, cement-emulsion filler surfaces shall be

dampened lightly with a fog spray of potable water immediately prior to application of the subsequent paint coat.

3.4.5.2 Latex Filler

Latex filler, CID A-A-1500, shall be applied according to the manufacturer's instructions. Surface voids shall be filled and excess filler shall be removed from the surface with a rubber squeegee. The filler shall be allowed to dry the length of time specified by the manufacturer prior to applying successive coats of paint.

3.4.6 Textured Coating

Application of textured coating, FS TT-C-555, shall be as specified in the manufacturer's printed directions at a rate of 45 to 55 square feet per gallon in one coat.

3.4.7 Ferrous-Metal Primer

Primer for ferrous-metal shall be applied to ferrous surfaces to receive paint other than asphalt varnish prior to deterioration of the prepared surface. The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

3.5 SURFACES TO BE PAINTED

Surfaces listed in the painting schedules at the end of this section, other than those listed in paragraph SURFACES NOT TO BE PAINTED, shall be painted as scheduled.

3.6 SURFACES NOT TO BE PAINTED

Surfaces of hardware, fittings, and other factory finished items shall not be painted.

3.7 CLEANING

Cloths, cotton waste and other debris that might constitute a fire hazard shall be placed in closed metal containers and removed at the end of each day. Upon completion of the work, staging, scaffolding, and containers shall be removed from the site or destroyed in an approved manner. Paint and other deposits on adjacent surfaces shall be removed and the entire job left clean and acceptable.

3.8 PAINTING SCHEDULES

The following painting schedules identify the surfaces to be painted and prescribe the paint to be used and the number of coats of paint to be applied. Contractor options are indicated by -----or----- between optional systems or coats.

EXTERIOR PAINTING SCHEDULE

Surface	First Coat	Second Coat	Third Coat
Concrete masonry units.	Cement-emulsion filler	FS TT-P-19	None
	CID A-A-1500	FS TT-P-19	None
	FS TT-P-19	FS TT-P-19	None

NOTE: Cement-emulsion filler coat shall be acrylic-based and shall consist of the following ingredients in the proportion stated: white portland cement, ASTM C 150, Type I, 7.5 kg (16.5 pounds); aggregate 15 kg (33.5 pounds); mixing liquid, factory-prepared acrylic containing 46 to 47 percent solids, 3 liters (0.75 gallon); potable water 4 liters (1.0 gallon) maximum; exterior emulsion paint, FS TT-P-19 4 liters (1.0 gallon). Aggregate shall consist of Washed silica sand of the following gradation:

U.S. Sieve Size	Percent Sand (by Weight) Passing Individual Sieve
0.850 mm (20)	100
0.600 mm (30)	95 - 100
0.300 mm (50)	30 - 65
0.150 mm (100)	0 - 10
0.075 mm (200)	0 - 1

Concrete, unless otherwise specified.	FS TT-P-19	FS TT-P-19	None
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INTERIOR PAINTING SCHEDULE

Surface	First Coat	Second Coat	Third Coat
Plaster, gypsum board, concrete, and concrete masonry units not requiring a smooth finish, unless otherwise specified		CID A-A-2247	None
Concrete masonry units requiring a smooth finish			CID A-A-2247
Ferrous metal unless otherwise specified.	SSPC Paint 25	FS TT-P-38	FS TT-P-38
Oil-based caulking compound.	FS TT-P-38	Same as adjacent areas	

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SECTION 10160

TOILET PARTITIONS

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities
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FEDERAL SPECIFICATIONS (FS)

FS RR-P-1352	(Rev C) Partitions, Toilet, Complete
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FEDERAL STANDARDS (FED-STD)

FED-STD 795	(Basic) Uniform Federal Accessibility Standards
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1.2 SYSTEM DESCRIPTION

Toilet partition system, including toilet enclosures, room entrance screens, and urinal screens, shall be a complete and usable system of panels, hardware, and support components. The partition system shall be provided by a single manufacturer and shall be a standard product as shown in the most recent catalog data. The partition system shall comply with FED-STD 795 and 36 CFR 1191 for areas as shown.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-01 Data

Toilet Partition System; FIO.

Manufacturer's technical data and catalog cuts including installation and cleaning instructions.

SD-04 Drawings

Toilet Partition System; FIO.

Drawings showing plans, elevations, details of construction, hardware, reinforcing, fittings, mountings, and anchorings.

SD-14 Samples

Toilet Partition System; GA.

Manufacturer's standard color charts and color samples.

1.4 DELIVERY, STORAGE, AND HANDLING

Components shall be delivered to the jobsite in the manufacturer's original packaging with the brand, item identification, and project reference clearly marked. Components shall be stored in a dry location that is adequately ventilated and free from dust, water, or other contaminants and shall have easy access for inspection and handling.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 - PRODUCTS

2.1 TOILET ENCLOSURES

Toilet enclosures shall conform to FS RR-P-1352, Type I, Style A. Width, length and height of toilet enclosures shall be as shown. Finish surface of panels shall be baked enamel finish 1. Panels indicated to receive toilet paper holders or grab bars as specified in Section 10800 - TOILET ACCESSORIES shall be reinforced for the reception of the items required. Grab bars shall comply with FED-STD 795 and 36 CFR 1191.

2.2 HARDWARE

Hardware for the toilet partition system shall conform to FS RR-P-1352 for the specified type and style of partitions. Hardware finish shall be highly resistant to alkalies, urine, and other common toilet room acids.

2.3 COLORS

Color of finishes for toilet partition system components shall be selected from the manufacturer's standard colors.

PART 3 - EXECUTION

3.1 INSTALLATION

Toilet partitions shall be installed straight and plumb in accordance with approved manufacturer's instructions with horizontal lines level and rigidly anchored to the supporting construction. Where indicated, anchorage to walls shall be by through-bolting. Drilling and cutting for installation of anchors shall be at locations that will be concealed in the finished work.

3.2 ADJUSTING AND CLEANING

Doors shall have a uniform vertical edge clearance of approximately 5 mm (3/16 inch) and shall rest open at approximately 30 degrees when unlatched. Baked enamel finish shall be touched up with the same color of paint that was used for the finish. Toilet partitions shall be cleaned in accordance with approved manufacturer's instructions and shall be protected from damage until accepted.

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SECTION 10800 - TOILET ACCESSORIES

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

FEDERAL SPECIFICATIONS (FS)

FS DD-M-411	(Rev C) Mirrors, Glass
FS WW-P-541/GEN	(Rev E; Am 1) Plumbing Fixtures
FS WW-P-541/8	(Rev B; Am 1) Plumbing Fixtures (Accessories, Land Use)

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation, submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-01 Data

Finishes; FIO.

Accessory Items; FIO.

Manufacturer's descriptive data and catalog cuts indicating materials of construction, fasteners proposed for use for each type of wall construction, mounting instructions, and operation instructions.

1.3 DELIVERY, STORAGE, AND HANDLING

Toilet accessories shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area protected from construction damage and vandalism.

PART 2 - PRODUCTS**2.1 MANUFACTURED UNITS**

Toilet accessories shall be provided where indicated in accordance with paragraph SCHEDULE. Each accessory item shall be complete with the necessary mounting plates.

2.1.1 Anchors and Fasteners

Anchors and fasteners shall be capable of developing a restraining force commensurate with the strength of the accessory to be mounted and shall be

suited for use with the supporting construction. Exposed fasteners shall be of tamperproof design and shall be finished to match the accessory.

2.1.2 Finishes

Finishes on metal shall be provided as follows:

<u>Metal</u>	<u>Finish</u>
Stainless steel	No. 4 satin finish
Carbon steel, copper alloy, and brass	Chromium plated, bright

2.2 ACCESSORY ITEMS

Accessory items shall conform to the requirements specified below. Sizes shall be in accordance with paragraph SCHEDULE.

2.2.1 Grab Bar (GB)

Grab bar shall conform to FS WW-P-541/GEN and FS WW-P-541/8, Type IV, Class 2, 1-1/4 inches OD stainless steel. Concealed mounting flange shall have set screw mounting holes concealed on the lip of the flange. Grab bar shall have peened non-slip surface. Installed bars shall be capable of withstanding a 500 pound vertical load without obvious permanent deformation.

2.2.2 Mirror, Glass (MG)

Glass mirror shall conform to FS DD-M-411, Class 2, Style E Grade 1.

2.2.3 Combination Paper Towel Dispenser/Waste Receptacle Units (PTDWR)

Dispenser/receptacle shall be semi-recessed and shall have a capacity of 400 sheets of C-fold, single-fold, or quarter-fold towel. Waste receptacle shall be designed to be locked in unit and removable for service. Locking mechanism shall be tumbler key lock. Waste receptacle shall have a capacity of 12 gallons. Unit shall be fabricated of 0.30 inch stainless steel welded construction with a satin finish. Waste receptacle that accepts reusable liner standard for unit manufacturer shall be provided.

2.2.4 Soap Dispenser (SD)

Soap dispenser shall be surface mounted, liquid type consisting of a vertical Type 304 stainless steel tank with holding capacity of 40 fluid ounces with a corrosion-resistant all-purpose valve that dispenses liquid soaps, lotions, detergents and antiseptic soaps.

2.2.5 Shelf, Metal, Heavy Duty (SMHD)

Heavy duty metal shelf shall conform to FS WW-P-541/GEN and FS WW-P-541/8, Type V, Class 2, stainless steel with hemmed edges. Separate supports shall be stainless steel.

2.2.6 Toilet Tissue Dispenser (TTD)

Toilet tissue holder shall be Type II - surface mounted with two rolls of tissue stacked vertically. Cabinet shall be stainless steel, satin finish.

PART 3 - EXECUTION**3.1 INSTALLATION**

Toilet accessories shall be securely fastened to the supporting construction in accordance with the manufacturer's approved instructions.

3.2 SCHEDULE

Room or Space	Accessories Required					
	MG	PTDWR	SMLD	SD	GB	TTD
104A	1	1		1		1
109			1			
110	1	1		1	2	1

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SECTION 13958

FORCED ENTRY RESISTANT COMPONENTS

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 500	(1989) Test Methods for Louvers, Dampers, and Shutters
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ALUMINUM ASSOCIATION (AA)

AA DAF-45	(1980) Designation System for Aluminum Finishes
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AA SAA-46	(1978) Standards for Anodized Architectural Aluminum
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
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ASTM A 525	(1993) General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
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ASTM C 1036	(1991) Flat Glass
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ASTM C 1048	(1992) Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
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ASTM C 1172	(1991) Laminated Architectural Flat Glass
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ASTM D 256	(1993a) Determining the Pendulum Impact of Notched Specimens of Plastic
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ASTM D 542	(1990) Index of Refraction of Transparent Organic Plastics
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ASTM D 570	(1981; R 1988) Water Absorption of Plastics
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ASTM D 635	(1991) Rate of Burning and/or Extent and Time of Self-Supporting Plastics in a Horizontal Position
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ASTM D 637	(1990) Surface Irregularities of Flat Transparent Plastic Sheets
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ASTM D 638	(1994b) Tensile Properties of Plastics
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ASTM D 648	(1982; R 1988) Deflection Temperature of Plastics Under Flexural Load
ASTM D 696	(1991) Coefficient of Linear Thermal Expansion of Plastics Between minus 30 degrees C and 30 degrees C
ASTM D 792	(1991) Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D 882	(1991) Tensile Properties of Thin Plastic Sheeting
ASTM D 905	(1989) Strength Properties of Adhesive Bonds in Shear by Compression Loading
ASTM D 1003	(1992) Haze and Luminous Transmittance of Transparent Plastics
ASTM D 1044	(1994) Resistance of Transparent Plastics to Surface Abrasion
ASTM D 1922	(1993) Propagation Test Resistance of Plastic Film and Thin Sheeting by Pendulum Method
ASTM D 3029	(1993) Impact Resistance of Flat Rigid Plastic Specimens by Means of a Tup (Falling Weight)
ASTM D 3595	(1991) Polychlorotrifluoroethylene (PCTFE) Extruded Plastic Sheet and Film
ASTM D 3951	(1990) Commercial Packaging
ASTM D 4093	(1993) Photoelastic Measurements of Birefringence and Residual Strains in Transparent or Translucent Plastic Materials
ASTM D 4802	(1994) Poly(Methyl Methacrylate) Acrylic Plastic Sheet
ASTM E 90	(1990) Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
ASTM E 152	(1991a) Fire Test of Door Assemblies
ASTM E 168	(1992) General Techniques of Infrared Quantitative Analysis
ASTM E 169	(1993) General Techniques of Ultraviolet-Visible Quantitative Analysis
ASTM E 204	(1992) Identification of Material by Infrared Absorption Spectroscopy, Using the ASTM Coded Band and Chemical Classification Index

ASTM E 831	(1993) Linear Thermal Expansion of Solid Materials by Thermomechanical Analysis
ASTM E 1300	(1994) Determining the Minimum Thickness and Type of Glass Required to Resist a Specific Load
ASTM F 428	(1983; R 1989) Test Method for Intensity of Scratches on Aerospace Glass Enclosures
ASTM F 520	(1977; 1989) Environmental Resistance of Aerospace Transparencies
ASTM F 521	(1983; 1989) bond Integrity of Transparent Laminates
ASTM F 548	(1981; R 1994) Test Method for Intensity of Scratches on Aerospace Transparent Plastics
ASTM F 735	(1994) Abrasion Resistance of Transparent Plastics and Coatings Using the Oscillating Sand Method
ASTM F 791	(1982; 1988) Stress Crazing of Transparent Plastics
ASTM F 1233	(1993) Security Glazing Materials and Systems
ASTM G 26	(1993) Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1994) Structural Welding Code - Steel
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BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.1	(1988) Butts and Hinges
BHMA A156.4	(1992) Door Controls - Closers
BHMA A156.5	(1992) Auxiliary Locks & Associated Products
BHMA A156.8	(1988) Door Controls - Overhead Holders
BHMA A156.13	(1987) Mortise Locks & Latches
BHMA A156.16	(1989) Auxiliary Hardware
BHMA A156.18	(1987) Materials and Finishes

DEPARTMENT OF STATE (SD)

SD Std-01.01	(Rev G Amended; Inx Certified Prod/Mfg) Certification Standard Forced Entry and Ballistic Resistance of Structural Systems
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DOOR AND HARDWARE INSTITUTE (DHI)

DHI A115.1 (1990) Preparation of 1-3/8" and 1-3/4" Standard Steel Doors and Steel Frames for Series 1000 Mortise Locks and Latches

FLAT GLASS MARKETING ASSOCIATION (FGMA)

FGMA-01 (1990) Glazing Manual

H. P. WHITE LABORATORIES (HPW)

HPW TP-0500.02 (1993) Transparent Materials and Assemblies for Use in Forced Entry or Containment Barriers

HPW TP-0502.01 (1989) Forced Entry Resistance of Structural Materials (Opaque and Transparent); Test Procedures and Acceptance Criteria

HPW TP-0506.00 (1993) Forced Entry Resistance of Security Structures and Structural Subassemblies VERY LOW THREAT LEVEL

HPW TP-0507.00 (1993) Forced Entry Resistance of Security Structures and Structural Subassemblies LOW THREAT LEVEL

HPW TP-0508.00 (1993) Forced Entry Resistance of Security Structures and Structural Subassemblies MEDIUM THREAT LEVEL

HPW TP-0509.00 (1993) Forced Entry Resistance of Security Structures and Structural Subassemblies HIGH THREAT LEVEL

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM HMMA 801 (1987) Glossary of Terms for Hollow Metal Door and Frames

NAAMM HMMA 802 (1992) Manufacturing of Hollow Metal Doors and Frames

NAAMM HMMA 810 (1987) Hollow Metal Manual; Section: Manufacturing of Hollow Metal Doors and Frames

NAAMM HMMA 820 (1987) Hollow Metal Manual; Section: Hollow Metal Frames

NAAMM HMMA 830 (1987) Hollow Metal Manual; Section: Hardware Preparation and Locations for Hollow Metal Doors and Frames

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (1992) Fire Doors and Windows

NFPA 80A (1993) Protection of Buildings from Exterior Fire Exposures

UNDERWRITERS LABORATORIES (UL)

UL 10B (1993) Fire Tests of Door Assemblies

1.2 COMPONENT DESCRIPTION

Components covered in this specification are designed to resist forced entry attacks with increasing severity levels of hand, power, and thermal tools and weapons and explosives. The components include forced entry resistant personnel door/frame assemblies, windows. Each type of forced entry resistant component shall be a complete assembly produced by a single manufacturer. Movable and operable components shall operate smoothly and freely. Items for exterior installation shall be designed to resist water and vapor penetration or entrapment.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Forced Entry Resistant Components; GA.

Manufacturer's descriptive data and finish samples. The forced entry resistant door lock functions, for selection by the Contracting Officer. Airflow calculations for louvers.

SD-04 Drawings

Forced Entry Resistant Components; GA.

Drawings showing anchorage of components and appurtenances into the actual surrounding construction and clearances for operation. Drawings sufficient to show hardware location and installation details. Complete drawings for forced entry resistant prefabricated guardhouses.

SD-06 Instructions

Forced Entry Resistant Components; FIO.

A copy of installation instructions and recommended cleaning and maintenance instructions.

SD-07 Schedules

Forced Entry Resistant Components; GA.

Lists including schedule of components to be incorporated in the work with manufacturer's model or catalog numbers, specification and drawing reference

numbers, warranty information, threat level designated, insulation "U" value, and number of items provided. Listing of similar products that have been satisfactorily in use for two years or more, including name of purchasers, locations of installations, dates of installations, and service organizations.

SD-13 Certificates

Forced Entry Resistant Components; GA.

Manufacturer's certificates attesting that components conform to the requirements on drawings and in specifications. Testing reports from independent testing laboratories indicating conformance to regulatory requirements shall be included. Fire rated doors may be furnished with certificate in lieu of a label. Certificate shall indicate compliance with the requirements for doors of the type and fire rating class. Manufacturer shall certify that compliance with the installation instructions and/or drawings will provide the specified degree of forced entry resistance.

1.4 STANDARD PRODUCTS

Each type of forced entry resistant component shall be the standard product of a manufacturer regularly engaged in the manufacture of such products and shall duplicate items that have been tested and approved in accordance with the forced entry test standard specified in paragraph COMPONENT TEST REQUIREMENTS. Manufacturer's descriptive data, installation instructions, and certificate and test report showing compliance with the specified forced entry test standard as specified in paragraph COMPONENT TEST REQUIREMENTS shall be submitted for all components. Drawings shall be submitted. Manufacturer's certificate shall be submitted indicating that compliance with the installation instructions and drawings will provide the specified degree of forced entry resistance.

1.5 COMPONENT TEST REQUIREMENTS

Forced entry resistant components shall be certified as resistant to the forced entry test standards indicated herein. Forced entry resistant components shall be tested as specified below. The test results and certification thereof shall be approved by the Contracting Officer before delivery of the component to the job site.

Component	Test Standard	Level Within Test	Minimum Attack
		Standard (If Any)	Time (Minutes)
Door and Windows	SD Std-01.01	60 Minute	60]

1.6 QUALIFICATIONS

Welding procedures, welders, and welding operators shall be qualified in accordance with AWS D1.1.

1.7 DELIVERY, STORAGE, AND HANDLING

Components shall be delivered to the job site with the manufacturer, name, and model number clearly marked thereon. Components shall be delivered, stored, and handled so as not to be damaged or deformed and shall be in accordance with ASTM D 3951. Components shall be handled carefully to prevent damage to the faces, edges, corners, ends, and glazing where applicable. Abraded, scarred, or rusty areas shall be cleaned, repaired, or replaced immediately upon detection of the damage. Damaged components that cannot be restored shall be replaced. Components and equipment shall be stored in a dry location on platforms or pallets that are ventilated adequately, free of dust, water, and other contaminants, and stored in a manner which permits easy access for inspection and handling.

1.8 SEQUENCING AND SCHEDULING

When testing of a previously untested component is specified, sufficient lead time shall be allowed so that testing will not delay construction. The test results and component shall be approved by the Contracting Officer before delivery of the component to the job site.

1.9 WARRANTY

Manufacturer's warranty for 5 years shall be furnished for glazing materials. Warranty shall provide for replacement and installation of glazing if delamination, discoloration, or cracking or crazing occurs.

PART 2 - PRODUCTS

2.1 FORCED ENTRY RESISTANT PERSONNEL DOOR AND FRAME ASSEMBLIES

Doors and frames shall be factory fabricated assemblies. Sizes shall be as indicated. Doors shall be of steel, hardened steel, or be reinforced internally with steel shapes and clad with aluminum. Interior composition and reinforcement shall be determined by the manufacturer. Rubber silencers shall be installed on door frames. Exterior doors shall have top edges closed flush and sealed against water penetration, be insulated, and shall be provided with weatherstripping and thresholds. Locks and hinges shall be the same or equal in performance and number as the hardware used on the tested door. Lock and hardware shall be provided by the manufacturer as a complete assembly. Frames shall be furnished by the door fabricator, with anchorage to wall construction completely specified as to number of anchors, anchor size, material, and length.

2.1.1 Door and Frame Fabrication

The subsurfaces shall be flat, parallel, and plumb after fabrication. Doors shall be reinforced in accordance with manufacturer's design. Door frames shall be anchored as specified by the door manufacturer. The Contractor shall coordinate the door manufacturer's requirements for welding to wall reinforcement or casting frame embedments into wall before wall is placed. Steel door frames shall be mitered or coped and welded at the corners with welds ground smooth. Where structural channel frames are used the size, weight, stops, welding, and anchorage into surrounding construction must be

specified and tested along with the door as an assembly. Any necessary reinforcements in the door and the frame shall be made in the factory. Door and frame shall be drilled and tapped as required for the specified hardware. Frame channels shall be mitered or coped and welded at corners with full penetration groove welds. Exposed welds shall be dressed smooth. Hollow metal doors and frames shall be manufactured in accordance with NAAMM HMMA 801, NAAMM HMMA 802, NAAMM HMMA 810, and NAAMM HMMA 820 as a standard of quality, and shall meet the specified forced entry testing standard.

2.1.2 Sidelight Frames and Door Glazing

Sidelight frames shall be constructed using forced entry resistant door frame sections. For glazing in door or sidelight, stop height and rabbet depth shall be as required to accommodate the glazing material that is resistant to the forced entry test standard specified. The assembly shall be tested with the specified glazing and stops installed. Exterior (attack side) glazing stops shall be welded or integral to the frame. Interior (protected side) glazing stops shall be removable stops attached with high-strength alloy steel machine screws with tamper-resistant heads or as required by the manufacturer. Glazing is specified in paragraph Forced Entry Resistant Glazing Materials.

2.1.3 Preparation for Hardware

Doors and frames shall be prepared for hardware in accordance with manufacturer's instructions. Surface applied hardware shall be drilled and tapped in the field.

2.1.4 Hardware

Hardware for forced entry resistant door assemblies shall be provided by the door assembly manufacturer to ensure a complete forced entry resistant assembly. Where test standard requires hardware to be tested with the door assembly, locks and hinges shall be included in the labeling and/or test certification. Locks and hinges shall be the same or equal in performance, quality, grade, and quantity as used on the successfully tested door assembly in accordance with the specified forced entry testing standard. The Contractor shall provide certification that the locks, latches, and hinges provide the same degree of forced entry resistance as required by the specified forced entry testing standard. Keying shall be as specified in Section 08700 BUILDERS' HARDWARE.

2.1.4.1 Locks and Latchsets

The door manufacturer shall submit available lock functions for selection of function by the Contracting Officer. Mortise lock and latchsets shall be, as a minimum, series 1000, operational Grade 1, Security Grade 1 or 1A, and shall conform to BHMA A156.13. Strikes for mortise locks and latches (including deadbolt locks), as a minimum, shall conform to DHI A115.1 except strikes shall be rectangular (without curved lip). Mortise-type locks and latches for doors 1-3/4 inches thick and over shall have adjustable bevel fronts or otherwise conform to the shape of the door. Mortise locks shall have armored fronts. Mortise locks and latches shall have full escutcheon, through-bolted, extruded stainless steel trim. Lock finish shall be 652 in accordance with BHMA A156.18.

2.1.4.2 Hinges

Steel doors and frames required to resist the "very low" or "low" threat severity level that are up to and including 7 feet 0 inches high shall, as a minimum, be equipped with three Grade 1 hinges in accordance with BHMA A156.1, minimum size 5 inches high, heavy, double, or triple weight as required for weight of door. For each additional 12 inches of door height beyond 7 feet 0 inches, provide a minimum of one more hinge. Hinges shall be full mortise, half mortise, full surface, or half surface design as recommended by the manufacturer for frame and door design and shall be tamperproof unless mounted on the protected side of the door. Hinges shall have security pins and be equipped with a safety stud. Spot welding of hinge pin will not be acceptable. The Contractor shall provide hinge manufacturer's certification that the hinge supplied meets applicable test requirements for BHMA A156.1 type number of hinge specified and that the hinge is suitable for the size and weight of the door assembly on which it will be utilized. Continuous extra heavy-duty piano-type hinge sized to carry the weight of the door without sagging is permitted. If continuous piano-type hinges are provided with the door, independent laboratory reports covering both the door weight capacity and a 2,500,000 cycle testing to match the BHMA A156.1 Grade 1 requirements shall be furnished by the Contractor. Interior door hinges shall be furnished in prime coated steel. Exterior door hinges shall be furnished in nonferrous metal or stainless steel.

2.1.4.3 Door Closers

Closers shall be extra heavy duty of size and type recommended by the manufacturer and shall be Grade 1 conforming to BHMA A156.4. Door closer finish shall be 652 in accordance with BHMA A156.18.

2.1.4.4 Door Stops and Holders

Door stops and holders shall be extra heavy duty, conforming to BHMA A156.8, Type C08511 overhead surface mounted type.

2.1.5 Frame Anchors

Jamb and head anchors shall be provided with door/frame assembly and shall be as specified by the manufacturer and forced entry resistant to the same degree as the component. Contractor shall coordinate concrete work with component manufacturers when the manufacturer specifies frame anchors to be embedded into a concrete or concrete masonry unit surface during construction.

2.2 FORCED ENTRY RESISTANT WINDOW ASSEMBLIES

Forced entry resistant window assemblies shall be constructed using forced entry resistant frame sections. Frames shall be welded units of sizes and shapes indicated with minimum frame face dimensions of 2 inches. Frame anchorage shall be as specified by the manufacturer and forced entry resistant to the same degree as the component. Top height and rabbet depth shall be as required to accommodate the glazing material resistant to the forced entry test standard specified. Exterior (attack side) glazing stops shall be welded to or integral to the frame. Interior (protected side) glazing stops shall be removable stops attached with high-strength alloy steel machine screws with tamper-resistant heads, or as required by the manufacturer.

2.2.1 Speaking Apertures

Speaking apertures shall allow passage of voice at normal speaking volume without distortion and shall be fabricated to resist the referenced forced entry resistant standard for outdoor and indoor use. Speaking aperture shall be a welded subassembly of the window assembly and shall conform to the specified requirements for the entire window assembly.

2.2.2 Forced Entry Resistant Glazing Material

Glazing material shall be glass, and shall conform to applicable requirements ASTM C 1036, ASTM E 1300, and ASTM C 1048. Glazing materials shall be tested in accordance with the applicable sections of the following test procedures: ASTM D 905, ASTM D 1003, ASTM F 428, ASTM F 548, ASTM D 4093, and ASTM F 520. Plastic glazing shall be acrylic plastic sheets, polycarbonate plastic sheets, or approved equal. Plastic glazing shall be smooth and clear on both sides. Factory-glazed components shall be covered to protect them from damage during adjacent finish work.

2.2.2.1 Laminated Glass

Laminated glass shall be all glass laminated construction conforming to applicable sections of ASTM C 1172. The adhesive interlayer material for bonding glass to glass shall be chemically compatible with surfaces which are to be bonded. Materials selected for lamination purposes shall be tested in accordance with the following testing procedures: ASTM D 905, ASTM D 1044, ASTM F 735, ASTM D 4093, ASTM F 521, ASTM F 520, and ASTM D 1003. Glass plies used in the lamination shall be annealed float glass conforming to Type I, quality q3, Class 1, ASTM C 1036 or heat-strengthened or fully heat-tempered float glass, Condition A, Type I, quality q3, Class 1, ASTM C 1048.

2.2.2.2 Polycarbonate Plastic Sheets

Polycarbonate plastic sheet shall be laminated or solid, ultraviolet stabilized high abrasion resistant sheets shall conform to ASTM D 3595. Polycarbonate materials shall be tested in accordance with the applicable sections of the following testing procedures: ASTM D 256, ASTM D 3029, ASTM D 648, ASTM D 792, ASTM F 735, ASTM D 1003, ASTM D 635, ASTM D 638, ASTM D 1044, ASTM D 882, ASTM D 637, ASTM D 1922, ASTM D 570, ASTM F 520, ASTM E 168, ASTM E 169, ASTM E 204, ASTM G 26, and ASTM F 791. Polyvinyl butyryl shall not be used in contact with polycarbonate because its plasticizer may craze polycarbonate.

2.2.3 Adhesive Interlayer Materials

Adhesive interlayer material for bonding laminates (glass-glass, glass-plastic, or plastic-plastic bonds) shall be chemically compatible with the surfaces bonded. Interlayer materials may be polyvinyl butyryl, cast-in-place urethane, proprietary materials, sheet from urethane and other materials. Polyvinyl butyryl shall not be used to bond polycarbonate. Adhesives shall conform to ASTM D 905 and the manufacturer's recommendations.

2.2.4 Sealants

Sealants for glazings shall be chemically compatible with the glazing materials they are in contact with and shall have no deleterious effects to the glazing materials or to the adhesives used in glazing laminates. Sealants shall conform to the glazing manufacturer's recommendations and the requirements of FGMA-01.

2.3 ACCESSORIES

Accessories shall be provided for the installation of components into the surrounding structure. Anchorage shall be forced entry resistant to the same degree as the component. Installation shall be in accordance with the manufacturer's recommended instructions. Materials, parts, bolts, anchors, supports, braces, fasteners, and connections necessary for completion of the work.

2.4 LABELING

Forced entry resistant components shall be plainly and permanently labeled as to the applicable forced entry test standard and level within the test standard under which the component was tested and approved. Label shall be visible only from the protected side after component installation and shall include the following information: (1) manufacturer's name or identifying symbol; (2) model number, control number, or equivalent; (3) date of manufacture with the week, month or quarter, and year (this may be abbreviated or be in a traceable code such as the lot number); (4) correct mounting position (by removable label); and (5) forced entry resistant rating by indicating the test standard, level within the test standard (if any), and minutes of attack time withstood (if variable in the standard).

2.5 FABRICATION

Components shall be constructed, assembled, welded, and equipped with all hardware and accessories required to complete the assembly in the shop of a competent fabricator.

2.6 FASTENERS

Fasteners exposed to view shall match in color and finish and shall harmonize with the material to which fasteners are applied. Holes for bolts and screws shall be drilled or neatly punched. Poor matching of holes shall be cause for rejection of the work. Fasteners shall be concealed where practicable. Unless otherwise specified, fasteners shall conform to Section 05500 MISCELLANEOUS METAL.

2.7 SHOP/FACTORY FINISHING

Unless otherwise specified, all factory or manufactured components shall be shop finished as indicated below.

2.7.1 Ferrous Metal

Surfaces of ferrous metal, except galvanized and stainless steel surfaces, shall be cleaned and factory primed for painting. Finish painting shall be in accordance with Section 09900 PAINTING, GENERAL. Prior to shop painting, surfaces shall be cleaned with solvents to remove grease and oil and with

power wire-brushing or sandblasting to remove loose rust, loose mill scale, and other foreign substances. Surfaces of items to be embedded in concrete shall not be shop painted.

2.7.2 Galvanizing

Items specified to be galvanized shall be hot-dip processed after fabrication. Galvanizing shall be in accordance with ASTM A 123 or ASTM A 525.

2.7.3 Aluminum

Unless otherwise specified, aluminum items shall be standard mill finish. When anodic coatings are specified, coatings shall conform to AA SAA-46, with treatment to a coating thickness not less than that specified for protective and decorative type finish in AA DAF-45. Items to be anodized shall receive a polished satin finish pretreatment and a clear lacquer overcoat conforming to the above-referenced standard.

PART 3 - EXECUTION

3.1 PREPARATION AND PROTECTION

The Contractor shall field verify dimensions of rough openings for components and shall verify that surfaces of openings are level, plumb, and provide required clearances. Components shall be examined for racking, twisting, and other malformation and corrected prior to installation. Damaged components that cannot be corrected shall be replaced. The Contractor shall protect surrounding work prior to installation of forced entry resistant components. Surrounding work which is damaged as a result of the installation of forced entry resistant components shall be repaired in an approved manner prior to acceptance. Glazed units shall be protected from damage during adjacent work.

3.2 CORROSION PROTECTION - DISSIMILAR MATERIALS

Contact surfaces between dissimilar metals and aluminum surfaces in contact with concrete, masonry, pressure-treated wood, or absorptive materials subject to wetting shall be given a protective coating in accordance with Section 09900 PAINTING, GENERAL.

3.3 INSTALLATION

The finished work shall be free from defects. Components shall be installed plumb and level and secured rigidly in place. Components shall be installed in accordance with approved manufacturer's recommended instructions. Operable parts of components shall be tested for smooth operation in the presence of the Contracting Officer. The Contractor shall coordinate frame embedments into the construction where required by the component manufacturer. Materials which incur damage as a result of adjacent finish work shall be replaced or repaired as specified above. Window assemblies which are not specified as factory glazed shall have glazing installed in accordance with FGMA-01 and the manufacturer's recommended instructions. Field glazing shall occur only after concrete, masonry, ceiling, electrical, mechanical, plumbing and adjacent finish work has been completed. The Contractor shall be responsible for proper installation of forced entry resistant door assemblies so that operating clearances and bearing surfaces conform to the manufacturer's

instructions. The bottom of door frames shall be secured to the floor slab in accordance with the manufacturer's recommendations. Weatherstripping and thresholds shall be installed at exterior door openings to provide a weathertight installation.

3.4 ADJUSTING/CLEANING

Adjustments shall be made to assure smooth operation. Units shall be weathertight when closed and locked. All Components shall be cleaned in accordance with manufacturer's instructions. Only cleanser recommended by the manufacturer shall be used to clean polycarbonate, plastic, and applied hardcoats.

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SECTION 15250 - THERMAL INSULATION FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1991) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
ASTM A 580	(1991a) Stainless and Heat Resisting Steel Wire.
ASTM A 641	(1991) Zinc-Coated (Galvanized) Carbon Steel Wire.
ASTM B 209	(1990) Aluminum and Aluminum-Alloy Sheet and Plate.
ASTM C 449	(1988) Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
ASTM C 533	(1985; R 1990) Calcium Silicate Block and Pipe Thermal Insulation.
ASTM C 534	(1988) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
ASTM C 547	(1977) Mineral Fiber Preformed Pipe Insulation.
ASTM C 552	(1991) Cellular Glass Thermal Insulation.
ASTM C 553	(1970; R 1977) Mineral Fiber Blanket and Felt Insulation (Industrial Type).
ASTM C 612	(1983) Mineral Fiber Block and Board Thermal Insulation.
ASTM C 647	(1995) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C 795	(1989) Wicking-Type Thermal Insulation for Use Over Austenitic Stainless Steel.

ASTM C 916	(1985; Rev 1996) Adhesives for Duct Thermal Insulation
ASTM C 920	(1987) Elastomeric Joint Sealants.
ASTM C 921	(1989) Determining the Properties of Jacketing Materials for Thermal Insulation.
ASTM D 3278	(1996) Test Methods for Flash Point of Liquids by Small Scale & Closed-Cup Apparatus
ASTM E 84	(1996a) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials
FEDERAL SPECIFICATIONS (FS)	
FS L-P-535	(Rev E; Notice 2) Plastic Sheet (Sheeting): Plastic Strip: Poly (Vinyl Chloride) and Poly (Vinyl Chloride-Vinyl Acetate), Rigid.
MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)	
MSS SP-69	(1991) Pipe Hangers and Supports - Selection and Application.
MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)	
MICA-01	(1988) National Commercial and Industrial Insulation Standards.
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 90A	(1989) Installation of Air Conditioning and Ventilating Systems.
NFPA 90B	(1989) Installation of Warm Air Heating and Air Conditioning Systems.
NFPA 101	(1991) Safety to Life from Fire in Buildings and Structures.
NFPA 251	(1985) Fire Tests of Building Construction and Materials.

1.2 SYSTEM DESCRIPTION

Field-applied insulation and accessories on mechanical systems shall be as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated.

1.3 GENERAL QUALITY CONTROL

1.3.1 Standard Products

Materials shall be the standard products of manufacturers regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.3.2 Installer's Qualifications

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

1.3.3 Surface Burning Characteristics

Unless otherwise specified, installed insulation materials, adhesives, coatings, and other accessories shall have flame spread ratings and smoke developed ratings in accordance with NFPA 101, NFPA 90A, and NFPA 90B for the type occupancy and location that the material is installed unless the location where the material is installed is used as an air plenum in which case all materials shall have smoke developed ratings not greater than 50 and be non-combustible or limited combustible in accordance with NFPA 90A and NFPA 90B. All insulation shall be tested in the same densities and installed thicknesses as the material that will be used in actual construction applications. Compliance with the smoke developed limitation is not required and a greater flame spread rating up to 100 is permitted for insulation installed within wall assemblies or enclosures with a minimum fire resistance rating of 30 minutes in accordance with NFPA 251, which are not used as supply or return air plenums. Insulation that has been treated with a flame retardant additive to obtain the flame spread and smoke developed ratings shown above are not permitted.

1.3.4 Identification of Materials

Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and all samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

SD-01, Data

Thermal Insulation Materials; FIO.

A complete list of materials, including manufacturer's descriptive and technical literature, performance data (including fire resistance ratings), catalog cuts, and installation instructions. Materials furnished under this section of the specification shall be submitted at one time. A schedule

indicating the product number, k-value, thickness and furnished accessories for each mechanical system requiring insulation shall be included.

1.5 STORAGE

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants by the Contractor. Insulation material and supplies that become dirty, dusty, wet, or otherwise contaminated may be rejected by the Contracting Officer.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS

Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either the wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C 795 requirements. Materials shall be asbestos free and conform to the following:

2.1.1 Adhesives

2.1.1.1 Acoustical Lining Insulation Adhesive

Insulation shall be applied in cut-to-size pieces attached to the interior of the duct with a nonflammable, fire-resistant adhesive conforming to ASTM C 916, Type I. Exposed edges of the liner at the duct ends and at other joints where the lining will be subject to erosion shall be coated with a heavy brush coat of the nonflammable, fire-resistant adhesive to prevent delamination of glass fibers.

2.1.2 Contact Adhesive

Adhesive may be dispersed in a nonhalogenated organic solvent with a low flash point (flash point less than minus 25 degrees F when tested in accordance with ASTM D 3278) or, dispersed in a nonflammable organic solvent which shall not have a fire point below 200 degrees F. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The adhesive shall be nonflammable and fire resistant.

2.1.3 Caulking

ASTM C 920, Type S, Grade NS, Class 25, Use A.

2.1.4 Corner Angles

Nominal 0.016-inch aluminum 1-inch by 1-inch with factory applied kraft backing. Aluminum shall be ASTM B 209, Alloy 3003, 3105, or 5005.

2.1.5 Finishing Cement

Mineral fiber hydraulic-setting thermal insulating cement ASTM C 449.

2.1.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth and glass tape shall have flame spread and smoke developed ratings of no greater than 25/50 when measured in accordance with ASTM E 84. Fibrous glass cloth and tape shall be 20 x 20 maximum size mesh. Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces per square yard.

2.1.7 Staples

Outward clinching type monel or ASTM A 167, Type 304 or 316 stainless steel.

2.1.8 Jackets

ASTM C 921, Type I, moisture vapor transmission maximum 0.02 perms, puncture resistance minimum 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is allowable, tensile strength minimum 35 pound/inch width; Type II, puncture resistance minimum 25 Beach units, tensile strength minimum 20 pound/inch width. Aluminum jackets shall be corrugated, embossed or smooth sheet, 0.016-inch nominal thickness; ASTM B 209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105 with factory applied moisture barrier. Corrugated aluminum jacket shall not be used outdoors. Aluminum jacket securing bands shall be Type 304 stainless steel, 0.015-inch thick, 1/2-inch wide for pipe under 12-inch diameter and 3/4-inch wide for pipe over 12-inch diameter.

Aluminum jacket circumferential seam bands shall be 2-inch by 0.016-inch aluminum matching jacket material. Bands for insulation belowground shall be 3/4-inch by 0.020-inch thick stainless steel, or fiberglass reinforced tape. The jacket may, at the option of the Contractor, be provided with a factory fabricated Pittsburgh or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place. Polyvinyl chloride (PVC) jacket and fitting covers shall be FS L-P-535, Composition A, Type II, with minimum thickness 0.030-inch. Insulation under PVC jacket shall meet jacket manufacturer's written recommendations.

2.1.9 Vapor Retarder Coating

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall not exceed 0.05 perm and shall be determined according to procedure B of ASTM E 96 utilizing apparatus described in ASTM E 96. The coating shall be a nonflammable, fire resistant type. The flash point of the compound shall not be less than 80 degrees F and shall be determined in accordance with ASTM D 3278. All other application and service properties shall be in accordance with ASTM C 647.

2.1.10 Wire

Soft annealed ASTM A 580 Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

2.2 PIPE INSULATION MATERIALS

Pipe insulation materials shall be as follows:

2.2.1 Aboveground Cold Pipeline

Insulation for (Minus 30 degrees to Plus 60 degrees F) shall be as follows:

2.2.1.1 Flexible Cellular Insulation

ASTM C 534, Type I.

2.2.2 Aboveground Hot Pipeline (Above 60 degrees F) Insulation

2.2.2.1 Flexible Cellular Insulation

ASTM C 534, Type I to 200 degrees F service.

2.3 DUCT INSULATION MATERIALS

Duct insulation materials shall be as follows:

2.3.1 Rigid Mineral Fiber

ASTM C 612, Class 1.

2.3.2 Cellular Glass

ASTM C 552, Type I.

PART 3 - EXECUTION

3.1 APPLICATION - GENERAL

3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests and heat tracing specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry at all times. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if aforementioned cleaning does not restore the surfaces to like new condition, the insulation may be rejected, and if rejected, shall be immediately removed from the jobsite. Joints shall be staggered on multilayer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. All insulation, jacketing and accessories shall be installed in accordance with MICA-01 standard plates except where modified herein or on the drawings.

3.1.2 Fire Seal

Where pipes and ducts pass through fire walls, fire partitions, fire rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in SECTION: 07270 - FIRESTOPPING. Insulation and coverings for pipes and ducts which pass through the fire barrier shall be capable of maintaining the fire resistance of the fire barrier.

3.1.3 Painting and Finishing

Painting shall be as specified in SECTION: 09900 - PAINTING, GENERAL.

3.1.4 Flexible Cellular Insulation

Flexible cellular insulation shall be installed with seams and joints sealed with a contact adhesive. Flexible cellular insulation shall not be used on surfaces greater than 200 degrees F. Insulation exposed to weather and not shown to have jacketing shall be protected with two coats of UV resistant finish as recommended by the manufacturer after the adhesive is dry.

3.1.5 Welding

No welding shall be done on piping, duct or equipment without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

3.2 PIPE INSULATION INSTALLATION

3.2.1 Pipe Insulation

3.2.1.1 General

Pipe insulation shall be continuous and installed on all fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

- a. Pipe used solely for fire protection.
- b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.
- d. Sanitary drain lines, except those which receive condensate shall be insulated a minimum of 15 feet from point of connection to condensate line.
- e. Sanitary drain lines.
- f. Water hammer arrestors.

3.2.1.2 Pipes Passing Through Sleeves

- a. Pipe insulation shall be continuous through the sleeve except at firewall penetrations.
- b. An aluminum jacket with factory applied moisture barrier shall be provided over the insulation wherever penetrations require sealing.
- c. Where penetrating interior walls, the aluminum jacket shall extend 2 inches beyond either side of the wall and shall be secured on each end with a band.

3.2.1.3 Pipes Passing Through Hangers

- a. Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect insulation in accordance with MSS SP-69 without the use of high density insulation insert.

3.2.1.4 Flexible Cellular Pipe Insulation

Flexible cellular pipe insulation shall be tubular form for pipe sizes 5 inches and less. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation.

3.2.2 Aboveground Cold Pipelines (Minus 30 degrees to Plus 60 degrees F)

The following shall be included:

- a. Domestic cold and chilled drinking water.

3.2.3 Insulation Thickness

Thickness of insulation shall be as indicated in TABLE I.

TABLE I
Pipe Size (Inches)

Service or Range of Temp (degrees F)	Run- outs*	1/4 to 1-1/2	1/4 to 1-1/4	1-1/2 to 3	3-1/2 to 5	6 to 10	11 to 24	25 to 33
60 to 35 (FC)	1/2	1	1					
(CG)		1-1/2	1-1/2	2	2	2	2	2
(MF)		1	1	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2
34 to 0 (CG)		2-1/2	2-1/2	2-1/2	3	3	3-1/2	3-1/2
(MF)		1-1/2	1-1/2	2	2	2-1/2	2-1/2	2-1/2
-1 to -30 (CG)		3	3	3	3-1/2	3-1/2	4	
(MF)		1-1/2	2	2-1/2	2-1/2	3	3	
Domestic (FC)		1/2	1/2	1/2				
Cold Water (CG)		1	1	1	1-1/2	1-1/2	1-1/2	
and Interior (MF)		1/2	1/2	1/2	1	1	1	
Roof Drain Lines (Horizontal portions only)								

NOTES: CG - Cellular Glass
MF - Mineral Fiber
FC - Flexible Cellular

*When runouts to terminal units exceed 12 feet, the entire length of runout shall be insulated like the main feed pipe.

3.2.3.1 Jacket for Fibrous and Cellular Glass Insulated Pipe

Insulation shall be covered with a factory applied vapor barrier jacket or field applied seal welded PVC jacket. Insulation inside the building shown to be protected with an aluminum jacket shall have the insulation and vapor barrier jacket installed as specified herein. The aluminum jacket shall be installed as specified for piping exposed to weather, except sealing of the laps of the aluminum jacket is not required.

3.2.3.2 Insulation for Straight Runs (Fibrous and Cellular Glass)

a. Insulation shall be applied to the pipe with joints tightly butted. The ends of fibrous insulation shall be sealed off with vapor barrier coating at intervals not to exceed 15 feet.

b. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches. Butt strips 3-inches wide shall be provided for circumferential joints.

c. Laps and butt strips shall be secured with adhesive and stapled on 4-inch centers if not factory self-sealing.

d. Factory self-sealing lap systems may be used when the ambient temperature is between 40 degrees and 120 degrees F during installation. The lap system shall be installed in accordance with manufacturer's

recommendations. Stapler shall be used only if specifically recommended by the manufacturer. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.

e. Staples and seams, including those on self-sealing lap systems with adhesive on one side shall be coated with a vapor barrier coating. Double pressure-sensitive adhesive seams need not be coated.

f. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and securing it with adhesive, stapling, and coated with vapor barrier coating. The patch shall extend not less than 1-1/2 inches past the break.

g. At penetrations such as thermometers, the voids in the insulation shall be filled and sealed with vapor barrier coating.

3.2.3.3 Insulation for Fittings and Accessories

a. Pipe insulation shall have ends thoroughly coated with a vapor barrier coating not more than 6 inches from each flange, union, valve, anchor, or fitting in all directions.

b. Insulation may be premolded or segmented. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation should be overlapped 2 inches or one pipe diameter. Loose fill mineral fiber or insulating cement shall be used to fill the voids. Insulation for elbows less than 3-inch size shall be premolded. Insulation for elbows 3-inch size and larger shall be either premolded or segmented. Elbows insulated using segments shall not have less than 3 segments per elbow. Insulation may be secured by wire or tape until finish is applied.

c. Upon completion of installation of insulation on flanges, unions, valves, strainers, anchors, fittings and accessories, all terminations and all insulation not protected by factory vapor barrier jackets or PVC fitting covers shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16th-inch, applied with glass tape embedded between coats. Tape seams shall overlap 1-inch. The coating shall extend out onto the adjoining pipe insulation 2 inches.

d. Anchors attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface.

e. Flexible connections at pumps and other equipment shall be insulated with 1/2-inch flexible cellular insulation, unless otherwise indicated.

f. Insulation shall be marked showing the location of all unions, strainers and check valves.

3.2.3.4 Optional PVC Fitting Covers

At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor barrier and embedded glass tape. Factory premolded insulation segments shall be used under the fitting covers

for elbows. Insulation segments shall be the same thickness as adjoining pipe insulation and the insulation shall be protected with one coat of vapor barrier coating under the PVC cover. The covers shall be secured by PVC vapor barrier tape, adhesive, seal-welding or with tacks made for securing PVC covers. All seams in the cover, and tacks and laps to adjoining pipe insulation jacket, will be sealed with vapor barrier tape to ensure that the assembly has a continuous vapor seal. Factory or fieldcut blanket insulation shall not be used on pipe below 60 degrees F.

3.2.4 Aboveground Hot Pipelines (Above 60 degrees F)

The following shall be included:

- a. Domestic hot water.

3.2.4.1 Insulation Thickness

Insulation thickness for pipelines handling 60 degrees F to 200 degrees F domestic hot water shall be as indicated in TABLE IV.

TABLE IV

REQUIRED THICKNESS (IN INCHES) OF PIPE INSULATION
FOR PIPES HANDLING DOMESTIC HOT WATER. MF - MINERAL FIBER
CG - CELLULAR GLASS FC - FLEXIBLE CELLULAR

Range of Service (degrees F)	Runouts* 1/4 to 1-1/2"	Pipe Size, Inches						
		2 or less	2-1/2 to 3	4	5 to 6	8	10	12
61 to 200 (MF)		1.0	1.5	1.5	1.5	1.5	1.5	1.5
(CG)		1.5	2.5	2.5	2.0	2.0	2.0	2.0
(FC) 1/2		1.0	1.5	1.5	1.5			

*When runouts to terminal units exceed 12 feet, the entire length of runout shall be insulated like the main feed pipe.

3.2.4.2 Jacket for Insulated Pipe

Insulation shall be covered with a factory applied Type II jacket or field applied aluminum where required or seal welded PVC.

3.2.4.3 Insulation for Straight Runs

- a. Insulation shall be applied to the pipe with joints tightly butted.
- b. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches, and butt strips 3 inches wide shall be provided for circumferential joints.
- c. Laps and butt strips shall be secured with adhesive and stapled on 4-inch centers if not factory self-sealing. Adhesive may be omitted where pipe is concealed.

d. Factory self-sealing lap systems may be used when the ambient temperature is between 40 degrees and 120 degrees F and shall be installed in accordance with manufacturer's instructions. Laps and butt strips shall be stapled whenever there is nonadhesion of the system. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.

e. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and be secured with adhesive and stapled on 4-inch centers if not factory self-sealing. Adhesive may be omitted where pipe is concealed. Patch shall extend not less than 1-1/2 inches past the break.

3.2.4.4 Insulation for Fittings and Accessories

a. The run of the line pipe insulation shall have the ends brought up to the item.

b. Insulation of the same thickness and conductivity as the adjoining pipe insulation, either premolded or segmented, shall be placed around the item abutting the adjoining pipe insulation, or if nesting size insulation is used, overlapping 2 inches or one pipe diameter. Loose fill mineral fiber or insulating cement shall be used to fill the voids. Insulation for elbows less than 3-inch size shall be premolded. Insulation for elbows 3-inch size and larger shall be either premolded or segmented. Elbows insulated using segments shall have not less than 3 segments per elbow. Insulation may be wired or taped on until finish is applied.

c. Upon completion of installation of insulation on flanges, unions, valves, strainers, anchors, fittings and accessories, all terminations and all insulation not protected by factory vapor barrier jackets or PVC fitting covers shall be protected with two coats of Class 1 adhesive applied with glass tape embedded between coats. Tape seams shall overlap 1-inch. Adhesive shall extend onto the adjoining insulation not less than 2 inches. The total dry film thickness shall be not less than 1/16-inch.

d. Insulation terminations shall be tapered to unions at a 45-degree angle.

e. At the option of the Contractor, factory premolded one- or two-piece PVC fitting covers may be used in lieu of the adhesive and embedded glass tape. Factory premolded segments or factory or field cut blanket insert insulation segments shall be used under the cover and shall be the same thickness as adjoining pipe insulation. The covers shall be secured by PVC vapor barrier tape, adhesive, seal-welding or with tacks made for securing PVC covers.

3.3 DUCT INSULATION INSTALLATION

Except for oven hood exhaust duct insulation, corner angles shall be installed on external corners of insulation on ductwork in exposed finished spaces before covering with jacket. Duct insulation shall be omitted on the following:

a. Factory fabricated double wall internally insulated duct.

3.3.1 Insulation and Vapor Barrier for Cold Air Duct (Below 60 degrees F)

Ducts and associated equipment shall be insulated to a thickness of 2 inches except relief ducts and fresh air intake ducts which shall be insulated 1-1/2 inches. The following shall be insulated:

- a. Supply ducts.
- b. Return air ducts.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf and rigid type where exposed, minimum density 3 pcf. Insulation for all round ducts shall be flexible type, minimum density 3/4 pcf with a factory Type I jacket. Fibrous and cellular glass insulation for exposed ducts shall be provided with either a factory-applied Type I vapor barrier jacket or a vapor barrier coating finish as specified. Fibrous and cellular glass insulation on concealed duct shall be provided with a factory-applied Type I vapor barrier jacket. Vapor barrier coating finish where indicated to be used shall be accomplished by applying two coats of vapor barrier coating with a layer of glass cloth embedded between the coats. The total dry film thickness shall be approximately 1/16-inch. Duct insulation shall be continuous through sleeves and prepared openings except fire wall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor barrier shall cover the collar and retaining angles of diffusers, registers and grilles. Vapor barrier materials shall be applied to form a complete unbroken vapor seal over the insulation.

3.3.1.1 Installation on Concealed Duct

- a. For rectangular, oval or round ducts, insulation shall be attached by applying Class 2 adhesive around the entire perimeter of the duct in 6-inch wide strips on 12-inch centers.

- b. For rectangular and oval ducts, 24 inches and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 18-inch centers and not more than 18 inches from duct corners.

- c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 18-inch centers and not more than 18 inches from duct corners.

- d. Insulation shall be impaled on the mechanical fasteners where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor barrier jacket joints overlap 2 inches. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hanger.

- e. Self-locking washers shall be installed where mechanical fasteners are used. The pin shall be trimmed back and bent over.

f. Jacket overlaps shall be secured under the overlap with Class 2 adhesive and stapled on 4-inch centers. Staples and seams shall be coated with a brush coat of vapor barrier coating.

g. Breaks in the jacket material shall be covered with patches of the same material as the vapor barrier. The patches shall extend not less than 2 inches beyond the break or penetration in all directions and shall be secured with Class 2 adhesive and staples. Staples and joints shall be sealed with a brush coat of vapor barrier coating.

h. At jacket penetrations such as hangers thermometers and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor barrier coating.

i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor barrier coating finish. The coating shall overlap the adjoining insulation and uninsulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

3.3.2 Ducts Handling Air for Dual Purpose (Below and Above 60 degrees F)

Ducts shall be insulated as specified for cold air duct.

3.3.3 Duct Test Holes

After all duct systems have been tested, adjusted, and balanced, all breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

3.3.4 Internally Lined Duct

Internally lined ductwork shall be used only where indicated on the drawings and shall be in accordance with the paragraph Acoustical Duct Lining, SECTION: AIR SUPPLY AND DISTRIBUTION (FOR AIR CONDITIONING). The insulation liner thickness shall be thermally equivalent to that specified hereinbefore.

3.4 EQUIPMENT INSULATION INSTALLATION

3.4.1 General

Removable insulation sections shall be provided to cover parts of equipment which must be opened periodically for maintenance including vessel covers, fasteners, flanges and accessories.

3.4.2 Insulation for Cold Equipment (Below 60 degrees F)

Insulation shall be furnished on all equipment handling media below 60 degrees F including the following:

- a. Air handling equipment parts that are not factory insulated.

3.4.2.1 Insulation Type

Insulation shall be suitable for the temperature encountered. Thicknesses shall be as follows:

a. Equipment Handling Media Between 35 degrees F and 60 degrees F: 1-1/2-inch thick mineral fiber, 2-inch thick cellular glass, or 1-1/2-inch thick flexible cellular.

3.4.3 Equipment Exposed to Weather

3.4.3.1 Installation

Equipment exposed to weather shall be insulated and finished in accordance with the requirements for ducts exposed to weather in paragraph DUCT INSULATION INSTALLATION.

3.4.3.2 Optional Panels

At the option of the Contractor, prefabricated metal insulation panels may be used in lieu of the insulation and finish previously specified. Thermal performance shall be equal to or better than that specified for field applied insulation. Panels shall be the standard catalog product of a manufacturer of metal insulation panels. Fastenings, flashing, and support system shall conform to published recommendations of the manufacturer for weatherproof installation that will prevent moisture from entering the insulation. Panels shall be designed to accommodate thermal expansion and to support a 250 pound walking load without permanent deformation or permanent damage to the insulation. Exterior metal cover sheet shall be aluminum and exposed fastenings shall be stainless steel or aluminum.

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SECTION 15330

WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47	(1990) Ferritic Malleable Iron Castings
ASTM A 53	(1995a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 135	(1993) Electric-Resistance-Welded Steel Pipe
ASTM A 183	(1983; R 1990) Carbon Steel Tract Bolts and Nuts
ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM A 795	(1995) Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.4	(1992) Cast Iron Threaded Fittings
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1991) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B18.2.1	(1981; Supple 1991; R 1992) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(1987; R 1993) Square and Hex Nuts (Inch Series)

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1013 (1993) Reduced Pressure Principle Backflow
Prevention Assembly

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA-10062JU (1992) Standard Methods for the Examination of
Water and Wastewater

AWWA B300 (1992) Hypochlorites

AWWA B301 (1992) Liquid Chlorine

AWWA C104 (1990) Cement-Mortar Lining for Ductile-Iron Pipe
and Fittings for Water

AWWA C110 (1993) Ductile-Iron and Gray-Iron Fittings, 3 In.
Through 48 In. (75 mm through 1200 mm), for Water
and Other Liquids

AWWA C111 (1990) Rubber-Gasket Joints for Ductile-Iron
Pressure Pipe and Fittings

AWWA C151 (1991) Ductile-Iron Pipe, Centrifugally Cast, for
Water or Other Liquids

AWWA C203 (1991) Coal-Tar Protective Coatings and Linings
for Steel Water Pipelines - Enamel and Tape -
Hot-Applied

AWWA M20 (1973) Manual: Water Chlorination Principles and
Practices

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825 (1998) Approval Guide

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-71 (1990) Cast Iron Swing Check Valves, Flanges and
Threaded Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13 (1996) Installation of Sprinkler Systems

NFPA 24 (1995) Installation of Private Fire Service Mains
and Their Appurtenances

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014 (1995) Program Detail Manual for Certification in
the Field of Fire Protection Engineering

Technology (Field Code 003) Automatic Sprinkler
System Layout

UNDERWRITERS LABORATORIES (UL)

UL-01	(1998) Building Materials Directory
UL-04	(1998) Fire Protection Equipment Directory
UL 668	(1989; Rev Feb 1994) Hose Valves For Fire Protection Service

1.2 GENERAL REQUIREMENTS

Wet pipe sprinkler system shall be provided in areas indicated on the drawings. The sprinkler system shall provide fire sprinkler protection for the entire area. Except as otherwise specified, the system shall be designed and installed in accordance with NFPA 13.

1.2.1 Hydraulic Design

Hydraulic calculations shall be in accordance with the Area/Density Method of NFPA 13.

1.2.1.1 Hose Demand

No allowance for exterior hose streams is required.

1.2.1.2 Basis for Calculations

No design is required. New branchlines for the system shall be sized per the Pipe Schedule Method as prescribed in NFPA 13.

1.2.2 Sprinkler Spacing

Spacing of sprinklers shall not exceed limits specified per the Pipe Schedule Method of NFPA 13 for light hazard occupancy.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. Submittals related to system configuration, hydraulic calculations, and equipment selection, including manufacturer's catalog data, working drawings, connection drawings, control diagrams and certificates shall be submitted concurrently as a complete package. The package will be reviewed by the U.S. Army Engineer District Fire Protection Engineer. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-01 Data

Load Calculations for Sizing Sway Bracing; FIO.

For systems that are required to be protected against damage from earthquakes, load calculations shall be provided for sizing of sway bracing.

Sprinkler System Equipment; GA.

Manufacturer's Catalog Data for each separate piece of equipment proposed for use in the system. Data shall indicate the name of the manufacturer of each item of equipment, with data highlighted to indicate model, size, options, etc. proposed for installation. In addition, a complete equipment list which includes equipment description, model number and quantity shall be provided.

SD-04 Drawings

Sprinkler System Shop Drawings; GA.

Detail drawings conforming to the requirements established for working plans as prescribed in NFPA 13. Each set of drawings shall include the following:

a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

b. Floor plans drawn to a scale not less than $1/8" = 1'-0"$ which clearly show locations of sprinklers, risers, pipe hangers, sway bracing, inspector's test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be indicated.

c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.

e. Details of each type of pipe hanger and sway bracing for earthquake protection.

As-Built Drawings; FIO.

As-built drawings, no later than 7 working days after completion of the Final Tests. The sprinkler system shop drawings shall be updated to reflect as-built conditions after work is completed and shall be on reproducible full-size mylar film.

SD-07 Schedules

Acceptance Test; GA.

Written notification shall be given to the Contracting Officer of the date for the final acceptance test. Notification shall be provided at least 3 days prior to the proposed start of the test.

SD-08 Statements

Installer Qualifications; GA.

Qualifications of the sprinkler installer.

Submittal Preparer's Qualifications; GA.

The name and documentation of certification of the individual who will prepare the submittals, prior to the submittal of the drawings.

1.4 SUBMITTAL PREPARER'S QUALIFICATIONS

The sprinkler system submittals, including as-built drawings, shall be prepared by an individual who is either a registered professional engineer or who is certified as a Level III or IV Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014.

1.5 INSTALLER QUALIFICATIONS

The installer shall be experienced and regularly engaged in the installation of the type and complexity of system included in this project. A statement prior to submittal of any other data or drawings, that the proposed sprinkler system installer is regularly engaged in the installation of the type and complexity of system included in this project shall be provided. In addition, data identifying the location of at least three systems recently installed by the proposed installer which are comparable to the system specified shall be submitted. Contractor shall certify that each system has performed satisfactorily, in the manner intended, for a period of not less than 6 months.

1.6 REGULATORY REQUIREMENTS

Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. Applicable material and installation standards referenced in Appendix A of NFPA 13 and NFPA 24 shall be considered mandatory the same as if such referenced standards were specifically listed in this specification. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. All requirements that exceed the minimum requirements of NFPA 13 shall be incorporated into the design. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

1.7 DELIVERY AND STORAGE

Equipment placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust or other contaminants.

PART 2 - PRODUCTS

2.1 GENERAL EQUIPMENT REQUIREMENTS

2.1.1 Standard Products

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate

items that have been in satisfactory use for at least 2 years prior to bid opening.

2.1.2 Requirements for Fire Protection Service

Equipment and materials shall have been tested by Underwriters Laboratories, Inc. and listed in UL-04 or approved by Factory Mutual and listed in FM P7825. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL-04 or FM P7825.

2.2 ABOVEGROUND PIPING SYSTEMS

Aboveground piping shall be steel.

2.2.1 Steel Piping System

2.2.1.1 Steel Pipe

Except as modified herein, steel pipe shall be black as permitted by NFPA 13 and shall conform to applicable provisions of ASTM A 795, ASTM A 53, or ASTM A 135. Pipe in which threads or grooves are cut shall be Schedule 40 or shall be listed by Underwriters' Laboratories to have a corrosion resistance ratio (CRR) of 1.0 or greater after threads or grooves are cut. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

2.2.1.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be cast iron conforming to ASME B16.4, steel conforming to ASME B16.9 or ASME B16.11, or malleable iron conforming to ASME B16.3. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings which use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

2.2.2 Pipe Hangers

Hangers shall be listed in UL-04 or FM P7825 and of the type suitable for the application, construction, and pipe type and sized involved.

2.3 SPRINKLERS

Sprinklers shall be used in accordance with their listed spacing limitations. Temperature classification shall be as indicated. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13.

2.3.1 Upright Sprinkler

Upright sprinkler shall be brass or chrome-plated type and shall have a nominal 1/2 inch orifice. Sprinkler shall be the quick-response type.

2.3.2 Pendent Sprinkler

Pendent sprinkler shall be of the fusible strut or glass bulb type, recessed type with nominal 1/2 inch orifice. Pendent sprinklers shall have a polished

chrome finish or a white enamel finish. Sprinklers shall be the quick-response type.

2.3.3 Sidewall Sprinkler

Sidewall sprinkler shall have a nominal 1/2 inch orifice. Sidewall sprinkler shall have a polished chrome finish. Sidewall sprinkler shall be the quick-response type.

2.4 DISINFECTING MATERIALS

2.4.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

2.4.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

2.5 ACCESSORIES

2.5.1 Sprinkler Cabinet

Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal or plastic cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided.

2.5.2 Pendent Sprinkler Escutcheon

Escutcheon shall be one-piece metallic type suitable for installation on recessed pendent sprinklers. The escutcheon shall have a factory finish that matches the pendent sprinkler heads.

2.5.3 Pipe Escutcheon

Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or set screw.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

The installation shall be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein.

3.2 ABOVEGROUND PIPING INSTALLATION

Piping shall be run straight and bear evenly on hangers and supports.

3.2.1 Piping in Exposed Areas

Exposed piping shall be installed so as not to diminish exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

3.2.2 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

3.2.3 Pendent Sprinklers

Drop nipples to pendent sprinklers shall consist of minimum 1 inch pipe with a reducing coupling into which the sprinkler shall be threaded. Hangers shall be provided on arm-overs to drop nipples supplying pendent sprinklers when the arm-over exceeds 12 inches. Where sprinklers are installed below suspended or dropped ceilings, drop nipples shall be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling shall not extend more than 1 inch below the underside of the ceiling. Recessed pendent sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area.

3.2.3.1 Pendent Sprinkler Locations

Pendent sprinklers in suspended ceilings shall be a minimum of 6 inches from ceiling grid.

3.2.4 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 30 inches in length shall be individually supported.

3.2.5 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings and fittings shall be from the same manufacturer.

3.2.6 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not

manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2 inch.

3.2.7 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes pass through fire walls, fire partitions, or floors, a fire seal shall be placed between the pipe and sleeve in accordance with Section 07270 - FIRESTOPPING. In penetrations which are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement which will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

3.2.8 Escutcheons

Escutcheons shall be provided for pipe penetration of ceilings and walls. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

3.2.9 Drains

Auxiliary drains shall be provided as required by NFPA 13 except that drain valves shall be used where drain plugs are otherwise permitted. Where branch lines terminate at low points and form trapped sections, such branch lines shall be manifolded to a common drain line.

3.3 STERILIZATION

After system components have been installed and pressure tested, each portion of the completed system shall be sterilized. After pressure tests have been made, the portion to be sterilized shall be thoroughly flushed with water until all entrained dirt and other foreign materials have been removed before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the sprinkler piping at a constant rate of 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or liquid chlorine injected into the system through a solution-fed chlorinator and booster pump, shall be used. Chlorination application shall continue until the entire system is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system shall be opened and closed several times to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. The system shall be then flushed with clean water until the residual chlorine is reduced to less than one part per million. Samples

of water in properly sterilized containers for bacterial examination will be taken from several system locations which are approved by the Contracting Officer. Samples shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA-10062JU. The testing method shall be either the multiple-tube fermentation technique or the membrane-filter technique. The sterilization shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.4 FIELD PAINTING AND FINISHING

Field painting and finishing are specified in Section 09900 - PAINTING, GENERAL.

3.5 ACCEPTANCE TESTS

The system shall be tested to assure that equipment and components function as intended. The piping system and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13. Upon completion of specified tests, the Contractor shall complete certificates as specified in paragraph SUBMITTALS.

3.5.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 200 psi and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

3.5.2 Testing of Alarm Devices

Each alarm switch shall be tested by flowing water through the inspector's test connection.

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SECTION 15405

PLUMBING, HOSPITAL

PART 1 - GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 1010	(1994) Drinking-Fountains and Self-Contained, Mechanically-Refrigerated Drinking-Water Coolers
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 42	(1993) Seamless Copper Pipe, Standard Sizes
ASTM B 75	(1993) Seamless Copper Tube
ASTM B 88	(1993a) Seamless Copper Water Tube
ASTM B 152	(1994) Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B 370	(1992) Copper Sheet and Strip for Building Construction
ASTM B 813	(1993) Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
ASTM D 2464	(1993) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1993) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1993) Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2468	(1993) Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 40
ASTM D 2485	(1991) Evaluating Coatings for High Temperature Service
ASTM D 2564	(1993) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2661	(1994a) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings

ASTM D 2665	(1994) Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2855	(1993) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 4551	(1991) Poly(Vinyl Chloride) (PVC) Plastic Flexible Concealed Water-Containment Membranes
ASTM E 1	(1995) ASTM Thermometers
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM F 409	(1993) Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.1.2	(1991) Air Gaps in Plumbing Systems
ASME A112.6.1M	(1988) Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.14.1	(1975; R 1990) Backwater Valves
ASME A112.18.1M	(1994; Errata Feb 1995) Plumbing Fixture Fittings
ASME A112.19.1M	(1994) Enameled Cast Iron Plumbing Fixtures
ASME A112.19.2M	(1990) Vitreous China Plumbing Fixtures
ASME A112.19.3M	(1987) Stainless Steel Plumbing Fixtures (Designed for Residential Use)
ASME A112.21.1M	(1991) Floor Drains
ASME A112.36.2M	(1991) Cleanouts
ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.4	(1992) Cast Iron Threaded Fittings
ASME B16.5	(1988; Errata Oct 88; B16.5a) Pipe Flanges and Flanged Fittings
ASME B16.12	(1991) Cast Iron Threaded Drainage Fittings
ASME B16.15	(1985; R 1994) Cast Bronze Threaded Fittings Classes 125 and 250
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings

- ASME B16.21 (1992) Nonmetallic Flat Gaskets for Pipe Flanges
- AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)
- ASSE 1001 (1990) Pipe Applied Atmospheric Type Vacuum Breakers
- ASSE 1003 (1981) Water Pressure Reducing Valves for Domestic Water Supply Systems
- ASSE 1005 (1993) Water Heater Drain Valves - 3/4-Inch Iron Pipe Size
- ASSE 1013 (1993) Reduced Pressure Principle Backflow Preventers
- ASSE 1018 (1986) Trap Seal Primer Valves Water Supply Fed
- ASSE 1037 (1990) Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures
- AMERICAN WATER WORKS ASSOCIATION (AWWA)
- AWWA B300 (1992) Hypochlorites
- AWWA B301 (1992) Liquid Chlorine
- AWWA M20 (1973) Manual: Water Chlorination Principles and Practices
- COPPER DEVELOPMENT ASSOCIATION (CA)
- CA 404/0-RR (1993) Copper Tube for Plumbing, Heating, Air Conditioning and Refrigeration
- COUNCIL OF AMERICAN BUILDING OFFICIALS (CAB)
- CAB A (1992; Errata Jun 1993) American National Standard for Accessible and Usable Buildings and Facilities
- MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)
- MSS SP-25 (1993) Standard Marking System for Valves, Fittings, Flanges and Unions
- MSS SP-58 (1993) Pipe Hangers and Supports - Materials, Design and Manufacture
- MSS SP-69 (1991) Pipe Hangers and Supports - Selection and Application
- MSS SP-72 (1992) Ball Valves with Flanged or Butt-welding Ends for General Service

MSS SP-73	(1991) Brazing Joints for Copper and Copper Alloy Pressure Fittings
MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves
MSS SP-84	(1990) Valves - Socket Welding and Threaded Ends
MSS SP-110	(1992) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

MILITARY STANDARDS (MIL-STD)

MIL-STD 1691	(Rev E) Construction and Material Schedule for Military Medical and Dental Facilities
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NATIONAL ASSOCIATION OF PLUMBING-HEATING-COOLING CONTRACTORS (NAPHCC)

NAPHCC-01	(1993; Supple 1994) National Standard Plumbing Code (Non-Illustrated Edition)
NAPHCC-02	(1993) National Standard Plumbing Code (Illustrated Edition)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA MG 1	(1993; Rev 1-1993; Rev 2-1995) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(1993) Installation of Air Conditioning and Ventilating Systems
NFPA 99	(1993) Health Care Facilities

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201	(1992) Water Hammer Arresters
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UNDERWRITERS LABORATORIES (UL)

UL 174	(1989; Rev thru Jan 1991) Household Electric Storage-Tank Water Heaters
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1.2 GENERAL REQUIREMENTS**1.2.1 Standard Products**

Specified materials and equipment shall be standard items of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least 2 years prior to bid opening.

1.2.2 Performance Requirements

1.2.2.1 Electrical Work

Motors, motor controllers and motor efficiencies shall conform to the applicable requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Electric motor-driven equipment specified herein shall be provided complete with motors. Equipment shall be rated at 60 Hz, single phase, ac unless otherwise indicated. Motors shall be open, dripproof type unless otherwise indicated. Where a motor controller is not provided in a motor-control center on the electrical drawings, a motor controller shall be provided with the mechanical equipment. Electrical characteristics shall be as indicated. Motor controllers shall be provided complete with properly sized thermal-overload protection in each ungrounded conductor, auxiliary contact, and other equipment at the specified capacity including an allowable service factor, and other appurtenances necessary for the motor control specified. Manual or automatic control and protective or signal devices required for operation herein specified and any wiring required to such devices not shown on the electrical drawings shall be provided under this section. Complete electrical schematic lineless or full line interconnection and connection diagram for each piece of mechanical equipment having more than one automatic or manual electrical control device shall be submitted for approval. Manual or automatic control and protective or signal devices required for operation herein specified and any wiring required to such devices not shown on the electrical drawings shall be provided under this section.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-04 Drawings

Plumbing System; FIO.

Detail drawings consisting of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operation of each system. Detail drawings for the complete plumbing system including piping layout and location of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams; and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support method. All mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

SD-06 Instructions

Framed Instructions; FIO.

Diagrams, instructions, and other sheets, prior to posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

SD-09 Reports

Tests; FIO.

Test reports in booklet form showing field tests performed to adjust each component and field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-19 Operation and Maintenance Manuals

Plumbing System; GA.

Six copies of the operation manual outlining the step-by-step procedures required for system startup, operation and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of the maintenance manual listing routine maintenance procedures, possible breakdowns and repairs. The manual shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed.

1.4 REGULATORY REQUIREMENTS

Plumbing work shall be in accordance with NAPHCC-01, unless otherwise stated and installed in accordance with NAPHCC-02.

1.5 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

PART 2 PRODUCTS**2.1 MATERIALS**

Materials for various services shall be in accordance with TABLES I and II. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF Std 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Polypropylene pipe and fittings shall conform to dimensional requirements of Schedule 40, Iron Pipe size. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing lead shall not be used in any potable water system. Hubless cast-iron soil pipe shall not be installed

under concrete floor slabs or in crawl spaces below kitchen floors. Plastic pipe shall not be installed in air plenums.

2.1.1 Pipe Joint Materials

Grooved pipe shall not be used. Joint and gasket materials shall conform to the following:

- a. Coupling for Hubless Cast-Iron Pipe: ASTM A 74, AWWA C606.
- b. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1.6 mm (1/16 inch) thick, and contain aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.
- c. Neoprene Gaskets for Hub and Spigot Cast-Iron Pipe and Fittings: CISPI HSN.
- d. Brazing Material: Brazing material shall conform to AWS A5.8, BCup-5.
- e. Brazing Flux: Flux shall be in paste or liquid form, be appropriate for use with brazing material, be lead free, have a 100 percent flushable residue, contain slightly acidic reagents, contain potassium bromides, and contain fluorides.
- f. Solder Material: Solder metal shall conform to ASTM B 32, 95-5 tin-antimony.
- g. Solder Flux: Flux shall be liquid form, non-corrosive, and shall conform to ASTM B 813, Standard Test 1.
- h. Polytetrafluoroethylene Tape, for use with Threaded Metal or Plastic Pipe, and Distilled Water-Piping: ASTM D 3308.
- i. Rubber Gaskets for Cast-Iron Soil Pipe and Fittings: ASTM C 564.
- j. Flexible Elastomeric Seals: ASTM D 3139, ASTM D 3212 or ASTM F 477.
- k. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D 2564 and ASTM D 2855.
- l. Flanged Fittings: Flanged fittings including flanges, bolts, nuts, bolt patterns, etc. shall be in accordance with ASME B16.5 Class 150 and shall have the manufacturers trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105. Blind flange material shall conform to ASTM A 516 cold service and ASTM A 515 for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193.
- m. Elastomeric Seals: Elastomeric seals (gaskets) for joining plastic pipe ASTM F 477: thermoplastic elastomeric seals (gaskets) for joining plastic pipe ASTM F 913.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

- a. Water Hammer Arresters: PDI WH 201.
- b. Copper, Sheet and Strip for Building Construction: ASTM B 370.
- c. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.
- d. Metallic Cleanouts: ASME A112.36.2M.
- e. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile, nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.
- f. Hypochlorites: AWWA B300.
- g. Liquid Chlorine: AWWA Be.
- h. Thermometers: ASTM E 1.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves shall be ball valves, unless otherwise specified or indicated. Valves 2-1/2 inches and smaller shall be bronze, with threaded bodies for pipe and solder-type connections for tubing.. Valves shall conform to the following standards:

<u>Description</u>	<u>Standard</u>
Ball Valves with Flanged or Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Backwater Valves	ASME A112.14.1
Vacuum Relief Valves	ASSE 1001

Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASSE 1005
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22, and ASME BPV IV

2.3.1 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22, have 3/4 inch minimum inlets, and 3/4 inch outlets for systems where the maximum rate of heat input is less than 59 kW (200,000 Btuh). The discharge pipe from the (P&T) valve shall be the size of the valve outlet.

2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with NAPHCC-01 and installed in accordance with NAPHCC-02. Fixtures for use by the physically handicapped shall be in accordance with CAB A117.1. Vitreous china, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports. Pipe, valves, and fittings exposed to view shall be chromium plated. Fixtures and trim not covered by MIL-STD 1691 shall be considered special, but shall be of equal quality and material. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years. Plastic in contact with hot water shall be suitable for 180 degree F water temperature. Plumbing fixtures shall be as listed below.

2.4.1 Flushometer Valves

Flushometer valves shall have a non-hold-open feature with backcheck angle control stop and a vacuum breaker. Flushometer valves shall be large diaphragm type, having a minimum upper chamber inside diameter of not less than 2-5/8 inches at the point where the diaphragm is sealed between the upper and lower chambers. Flushometer valves shall conform to ASSE 1037.

2.4.2 Joint Schedule Fixtures

The following Joint Schedule Numbers (JSN) for plumbing fixture items are as shown in MIL-STD 1691. Description of the fixture may vary from that in MIL-STD 1691.

a. Item P1600. Water cooler drinking fountains: Surface Wall-Mounted - Surface wall-mounted units shall be 13-1/4 inches wide, 13 inches deep, and have a back height of 6 to 8 inches. The bowl shall be made of corrosion resisting steel. The unit shall have concealed fasteners and be for interior installation. Drinking fountain, wall-mount, with push-button, and splash back shall be stainless steel bowl having rounded corners and edges. Each fixture shall be provided with a guarded angle stream nozzle head, self-closing control valve, automatic volume regulator, and loose key stop valve and strainers. Exposed surfaces of stainless steel shall have No. 4 general polish finish. The trap and bodies of regulating and control valves shall be concealed.

b. Item P1650. Drinking fountain, wall-mount, with push-button shall be stainless steel of one-piece with bowl having rounded corners and edges. Each fixture shall be provided with a guarded angle-stream nozzle head, self-closing valve, automatic volume regulator, loose key stop valve, and strainer. The trap and bodies of regulator and control valves shall be concealed.

c. Item P3530. Sink, bowl, single, stainless steel, 22 inches wide by 25 inches long. Faucet with 4 inch wrist handles and rigid connection to 3/8 inch gooseneck spout with aerator, outlet 5 inches above slab, and grid drain with 1-1/4 inch tailpiece.

d. Item P3550. Lavatory with back, 24 by 18 inches, Type 304 stainless steel, security fixture. Multiple hole fast drain with air vent, hot and cold self closing filler valve.

e. Item P-4. Sink, service, floor type, corner mounted; 28 by 28 by 8 inches; precast material or cast iron; complete with polished chrome plated combination hot-and-cold water faucet with integral stops; back flow preventer; and 5 feet of 3/8 inch cloth-reinforced rubber hose.

f. Item P9050. Water closet floor mounted, siphon-jet, elongated bowl shall conform to ASME A112.19.2M. Seat shall conform to CID A-A-238, SPN CEWX. Flushometer valve shall conform to ASSE 1037, SPN 1a3.5. The maximum water use allowed shall be 1.6 gallons per flush. Floor flange shall be cast iron, copper or copper alloy, with wax seal unless otherwise specified.

g. Item P9150. Cabinet, toilet/lavatory cabinet. Lavatory/toilet combination unit shall have 304 stainless steel cabinet frame, elongated siphon jet toilet and lavatory. Cabinet doors shall support 250 pound static load and floor-supported toilet shall support 2500 pound static load. Hot and cold filler valves shall be self closing type as required.

h. Item P9180. Lavatory, wheelchair, enameled cast iron, 20 by 27 inches with appropriate carrier for installation.

i. Item P9400. Water closet, handicapped, enameled cast iron, shall conform to ASME A112.19.2M, SPN SJEB203. Seat shall conform to CID A-A-238, SPN CEWX. Flushometer valve shall conform to ASSE 1037, SPN 2c3.5. The maximum water use allowed shall be 1.6 gallons per flush. Floor flange shall be cast iron, copper or copper alloy, with wax seal unless otherwise specified.

2.5 BACKFLOW PREVENTERS

Backflow preventers shall be approved and listed by the Foundation For Cross-Connection Control & Hydraulic Research. Reduced-pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCHR-01. Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Air gaps in plumbing systems shall conform to ASME A112.1.2.

2.6 DRAINS

2.6.1 Floor Drains

Floor drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron, except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drain pipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded or caulked connection. In lieu of a caulked joint between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C 564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor drains shall conform to ASME A112.21.1M.

2.7 WATER COOLERS

Self-contained, wall hung, mechanically refrigerated drinking water coolers shall conform to ARI 1010, shall use one of the halogenated hydrocarbons as a refrigerant, and shall have a capacity to deliver a minimum of 8 gph of 50 degree F water when supplied with 80 degree F inlet water and a 90 degree F room temperature.

2.8 TRAPS

Unless otherwise specified, traps shall be plastic in accordance with ASTM F 409 or copper alloy adjustable tube type with slip joint inlet and swivel. Traps shall be without a cleanout. Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for

slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A plastic or copper-alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast-brass wall flange, shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.9 WATER HEATERS

Water heater types and capacities shall be as indicated. Each water heater shall have controls adjustable from 120 to 160 degrees F. Hot water systems utilizing recirculation systems shall be tied into building off-hour controls. The thermal efficiencies and stand by heat losses shall conform to Table III, for each type of water heater specified.

2.9.1 Automatic Storage Type

Heaters shall be complete with control system, temperature gauge and shall have ASME rated combination pressure and temperature relief valve.

2.9.1.1 Electric Type

Electric type water heaters shall conform to UL 174 and have dual heating elements. Each element shall be 4.5 kW. The elements shall be wired so that only one element can operate at a time.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Hubless cast-iron pipe shall not be installed under concrete floor slabs. Piping located in air plenums shall conform to NFPA 90A requirements. Plastic pipe shall not be installed in air plenum. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA-01. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. A full port ball valve and drain on the water service line shall be installed inside the building where indicated. Piping shall be connected to the exterior service lines or capped or plugged, if the exterior service is not in place. Valves shall be installed with handle horizontal to or above the valve body.

3.2 WATER PIPE, FITTINGS, AND CONNECTIONS

3.2.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot water and cold water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flushing devices, or other control valves which are supplied with

integral stops, shall be equipped with a shutoff valve to enable isolation of the time for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.2.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting through construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.2.3 Protection to Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.2.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Buried pipe shall be inspected, tested, and approved before backfilling. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific excepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.2.5 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters, conforming to PDI WH 201, shall be provided on hot and cold water supplies with precise location and sizing per PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Vertical capped pipe columns will not be permitted.

3.3 JOINTS

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.3.1 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous pipe shall be made with dielectric unions, flanges or dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fittings for this specific purpose.

3.4 PIPE SLEEVES AND FLASHING

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.5 FIRE SEAL

Where pipes pass through fire walls, fire partitions, fire rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07270 FIRESTOPPING.

3.6 SUPPORTS

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run.

3.7 PIPE CLEANOUTS

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the

floor. Pipe cleanouts concealed in partitions shall be provided with chromium-plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the head cleanouts shall be provided with adjustable cast iron or plastic heads.

3.8 FIXTURES AND FIXTURE TRIMMINGS

Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, or sweat inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beaded tool shall be used to mechanically deform the tubing above the compression fittings. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown. Stops for water closet seats shall be installed on the wall.

3.8.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural-rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.8.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finish connection to top spud adjacent to valve, to the wall with approved metal bracket.

3.8.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 31 inches above finished floor. Wall-hung drinking fountains shall be installed with rim 42 inches above floor. Wall-hung service sinks shall be mounted with rim 28 inches above the floor. Installation of fixtures for use by the physically handicapped shall conform to CAB A117.1.

3.8.4 Shower Bath Outfits

The area around the water supply piping to the mixing valves and behind the escutcheon plate shall be made watertight by caulking or gasketing.

3.8.5 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.8.5.1 Concrete or Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

3.8.5.2 Cellular-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the cellular wall using through bolts and a back-up plate.

3.8.5.3 Steel Stud Frame Partitions

Chair carriers shall be used. The anchor feet and tubular uprights shall be of the heavy duty design. Feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, may be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.8.5.4 Wall-Mounted Water Closet Gaskets

When wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair carrier manufacturer.

3.8.6 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with NAPHCC-01 at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and

preclude the backflow of any nonpotable substance into the potable water system. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.8.7 Access Panels

Access panels shall be provided for concealed valves and controls or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in Section 05500 MISCELLANEOUS METAL.

3.8.8 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps for acid-resisting waste shall be of the same material as the pipe.

3.9 WATER HEATERS AND HOT WATER STORAGE TANKS

3.9.1 Relief Valves

Valves shall not be installed between a relief valve and its water heater or storage tank. The relief valves shall be installed where the valve actuator comes in contact with the hottest water in the heater or tank. Whenever possible, the valve shall be installed directly in a tapping in the tank or heater. When heaters are not provided with a relief valve tapping, the valve shall be installed in the hot water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the hot water storage tank or water heater and mounted above and within 6 inches of the tank or water heater.

3.9.2 Storage Water Heaters

Storage water heaters that are not equipped with integral heat traps and having vertical pipe risers shall be installed with heat traps directly on both the inlet and outlets. Circulating systems need not have heat traps installed. An acceptable heat trap may be a piping arrangement such as elbows connected so that the inlet and outlet piping make vertically upward runs of not less than 24 inches just before turning downward or directly horizontal into the water heater's inlet and outlet fittings. Commercially available heat traps, specifically designed by the manufacturer for the purpose of effectively restricting the natural tendency of hot water to rise through vertical inlet and outlet piping during standby periods, may also be approved.

3.9.3 Connections to Water Heaters

Connections to water heaters and metallic pipe shall be made with dielectric unions or flanges.

3.10 IDENTIFICATION SYSTEMS

3.10.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number, shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.10.2 Color Coding

Color coding for piping identification shall be as specified in Section 09900 PAINTING, GENERAL.

3.11 ESCUTCHEONS

Escutcheons shall be provided to finished surfaces where bare or insulated piping exposed to view passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one piece or split-pattern, held in place by internal spring tension or setscrew.

3.12 PAINTING

Painting of pipes, hangers, supports, and other iron work, in concealed spaces or exposed, is specified in Section 09900 PAINTING, GENERAL.

3.13 TESTS, FLUSHING, AND STERILIZATION

3.13.1 Plumbing System

The plumbing system shall be tested in accordance with NAPHCC-01.

3.13.1.1 Testing of Piping for Leaks

The completed piping system between turbine suction connection and operating separator connections shall be exhausted down to a vacuum of not less than 8 inches of mercury after initial drying out of pipeline. The pressure shall not increase by more than 0.4 inches of mercury in 1 hour. In the event vacuum does not hold, leaks shall be located and repaired, and testing redone until the required vacuum holds.

3.14 DEFECTIVE WORK

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new material. No caulking or screwed joints or holes will be acceptable.

3.15 SYSTEM FLUSHING

After tests are completed, potable water piping shall be flushed. In general, sufficient water shall be used to produce minimum water velocity of 2.5 feet per second through piping being flushed. Flushing shall be continued until

discharge water shows no discoloration. System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced in line. After flushing and cleaning, system shall be prepared for service by immediately filling water piping with clean, fresh potable or high-purity water as applicable to the system being flushed. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building, due to the Contractor's failure to properly clean the piping system, shall be repaired by the Contractor. When the work is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation.

3.15.1 Sterilization

After pressure tests have been made, the entire domestic hot-and-cold water distribution system to be sterilized shall be flushed with water until entrained dirt and other foreign material have been removed, before introducing chlorinating material. The chlorinating material shall be either liquid chlorine or hypochlorite. Water chlorination procedure shall be in accordance with AWWA Mr. The chlorinating material shall be constantly fed into (ppm). A properly adjusted hypochlorite solution injected into the mthe water piping system at a concentration of at least 50 parts per million ain with a hypochlorinator, or liquid chlorine injected into the main through a solution-feed chlorinator and booster pump, shall be used. The chlorine residual shall be checked at intervals to ensure that the proper level is maintained. Chlorine application shall continue until the entire main is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system being sterilized shall be opened and closed several times during the contact period to ensure its proper disinfection. Following the 24 hour period, no less than 25 ppm chlorine residual shall remain in the system. Water tanks shall be disinfected by the addition of chlorine directly to the filling water. Following a 6 hour period, no less than 50 ppm chlorine residual shall remain in the tank. The system, including the tanks, shall then be flushed with clean water until the residual chlorine is reduced to less than 1 ppm. During the flushing period each valve and faucet shall be opened and closed several times. From several points in the system, the Contracting Officer will take samples of water in properly sterilized containers for bacterial examination. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA-10062JU. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique. The sterilizing shall be repeated until tests indicate the absence of coliform organisms (zero-mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

		SERVICE					
Item No.	Pipe and Fitting Material	A	B	C	D	E	F
1	Polyvinyl chloride plastic drain, waste and vent pipe and fittings, ASTM D 2665	X	X	X	X		
A - Underground Building Soil, Waste and Storm Drain B - Aboveground Soil, Waste, Drain In Buildings C - Underground Vent D - Aboveground Vent E - Interior Rainwater Conductors Aboveground F - Corrosive Waste And Vent Above And Belowground * - Hard Temper							

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

		SERVICE							
Item No.	Pipe and Fitting Material	A	B	C	D	E	F	G	H
1	Seamless copper water tube, ASTM B 88	X*	X*	X*	X*	X**			
2	Unions, ASME B16.39; brass or bronze, fittings: ASME B16.15, ASME B16.18 and ASTM B 828, Composition B; carbon steel pipe unions socket welding and threaded, MSS SP-83; malleable-iron threaded union, ASME B16.39	X	X						
3	Nipples, pipe, threaded, ASTM A 733	X	X						

A - Cold Water Aboveground or Belowground

B - Hot Water 82 degrees C Maximum Aboveground

C - Compressed Air Non-Oil-Free

D - Compressed Medical (Oil-Free) And Vacuum

E - Nitrogen & Oxygen (Gaseous), Nitrous Oxide

F - Distilled Water

G - De-ionized Water

H - Aboveground only

Indicated types are minimum wall thicknesses.

* - Type L Hard

** - Type K Hard

TABLE III
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE
RATINGS FOR WATER HEATING EQUIPMENT

A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY GALLONS	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE
Elect.	120 max	12 kW max	10 CFR 430	EF = 0.95-0.00132V minimum
Elect.	120 min OR	12 kW min	ASHRAE 90.1 (Addenda 90.1b)	SL = 1.9 W/sq. ft. maximum

TERMS:

EF = Energy factor, overall efficiency.

ET = Thermal efficiency with 70 degrees F delta T.

EC = Combustion efficiency, 100 percent - flue loss when smoke = 0
(trace is permitted).SL = Standby loss in W/sq. ft. based on 80 degrees F delta T, or in
percent per hour based on nominal 90 degrees F delta T.

HL = Heat loss of tank surface area

V = Storage volume in gallons.]

3.16 FRAMED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

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SECTION 15488

GAS PIPING SYSTEMS

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.69 (1992; Z21.69a) Connectors for Movable Gas Appliances

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 6D (1994) Specification for Pipeline Valves (Gate, Plug, Ball, and Check Valves)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 539 (1990a) Electric-Resistance-Welded Coiled Steel Tubing for Gas and Fuel Oil Lines

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1 (1983; R 1992) Pipe Threads, General Purpose (Inch)

ASME B16.3 (1992) Malleable Iron Threaded Fittings

ASME B16.5 (1988; Errata Oct 88; B16.5a) Pipe Flanges and Flanged Fittings

ASME B16.9 (1993) Factory-Made Wrought Steel Buttwelding Fittings

ASME B16.11 (1991) Forged Fittings, Socket-Welding and Threaded

ASME B16.21 (1992) Nonmetallic Flat Gaskets for Pipe Flanges

ASME B16.33 (1990) Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig (Sizes 1/2 through 2)

ASME B31.1 (1995) Power Piping

ASME B31.2 (1968) Fuel Gas Piping

ASME B36.10M (1985; R 1994) Welded and Seamless Wrought Steel Pipe

ASME BPV IX (1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25 (1993) Standard Marking System for Valves, Fittings, Flanges and Unions

MSS SP-58 (1993) Pipe Hangers and Supports - Materials, Design and Manufacture

MSS SP-69 (1991) Pipe Hangers and Supports - Selection and Application

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54 (1992) National Fuel Gas Code

NFPA 70 (1996) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL-06 (1994; Supple; Rev thru March 1996) Gas and Oil Equipment Directory

1.2 GENERAL REQUIREMENTS

1.2.1 Welding

Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified at least 24 hours in advance of tests and the tests shall be performed at the work site if practicable. The Contracting Officer shall be furnished with a copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record.

1.2.2 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos shall not be used. Manufacturer's descriptive data and installation instructions shall be submitted for approval for compression-type mechanical joints used in joining dissimilar materials and for insulating joints. Valves, flanges and fittings shall be marked in accordance with MSS SP-25.

1.2.3 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-01 Data

Qualifications; FIO.

Qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

SD-04 Drawings

Gas Piping System; FIO.

Drawings showing location, size and all branches of pipeline; location of all required shutoff valves; and instructions necessary for the installation of connectors and supports.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

2.1.1 Steel Pipe, Joints, and Fittings

Steel pipe shall conform to ASME B36.10M. Malleable-iron threaded fittings shall conform to ASME B16.3. Steel pipe flanges and flanged fittings including bolts, nuts, and bolt pattern shall be in accordance with ASME B16.5. Wrought steel butt welding fittings shall conform to ASME B16.9. Socket welding and threaded forged steel fittings shall conform to ASME B16.11.

2.1.2 Steel Tubing, Joints and Fittings

Steel tubing shall conform to ASTM A 539. Tubing joints shall be made up with gas tubing fittings recommended by the tubing manufacturer.

2.1.3 Sealants for Steel Pipe Threaded Joints

Joint sealing compound shall be listed in UL-06, Class 20 or less. Tetrafluoroethylene tape shall conform to UL-06.

2.1.4 Identification

Pipe flow markings and metal tags shall be provided as required.

2.1.5 Flange Gaskets

Gaskets shall be nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR) suitable for a maximum 600 degree F service. NBR binder shall be used for hydrocarbon service.

2.1.6 Pipe Threads

Pipe threads shall conform to ASME B1.20.1.

2.1.7 Escutcheons

Escutcheons shall be chromium-plated steel or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screw.

2.1.8 Gas Transition Fittings

Gas transition fittings shall be manufactured steel fittings approved for jointing metallic and thermoplastic or fiberglass pipe. Approved transition fittings are those that conform to AGA-01 requirements for transitions fittings.

2.1.9 Insulating Pipe Joints**2.1.9.1 Insulating Joint Material**

Insulating joint material shall be provided between flanged or threaded metallic pipe systems where shown to control galvanic or electrical action.

2.1.9.2 Threaded Pipe Joints

Joints for threaded pipe shall be steel body nut type dielectric unions with insulating gaskets.

2.1.9.3 Flanged Pipe Joints

Joints for flanged pipe shall consist of full face sandwich-type flange insulating gasket of the dielectric type, insulating sleeves for flange bolts, and insulating washers for flange nuts.

2.2 VALVES

Valves shall be suitable for shutoff or isolation service and shall conform to the following:

2.2.1 Valves 2 Inches and Smaller

Valves 2 inches and smaller shall conform to ASME B16.33 and shall be of materials and manufacture compatible with system materials used.

2.3 PIPE HANGERS AND SUPPORTS

Pipe hangers and supports shall conform to MSS SP-58 and MSS SP-69.

PART 3 - EXECUTION

3.1 EXCAVATION AND BACKFILLING

3.1.1 Protection of Materials and Components

Pipe and tube openings shall be closed with caps or plugs during installation. Equipment shall be protected from dirt, water, and chemical or mechanical damage. At the completion of all work, the entire system shall be thoroughly cleaned.

3.1.2 Workmanship and Defects

Piping, tubing and fittings shall be clear and free of cutting burrs and defects in structure or threading and shall be thoroughly brushed and chip-and scale-blown. Defects in piping, tubing or fittings shall not be repaired. When defective piping, tubing, or fittings are located in a system, the defective material shall be replaced.

3.2 PROTECTIVE COVERING

3.2.1 Aboveground Metallic Piping Systems

3.2.1.1 Ferrous Surfaces

Shop primed surfaces shall be touched up with ferrous metal primer. Surfaces that have not been shop primed shall be solvent cleaned. Surfaces that contain loose rust, loose mill scale and other foreign substances shall be mechanically cleaned by power wire brushing and primed with ferrous metal primer. Primed surface shall be finished with two coats of exterior oil paint or vinyl paint.

3.3 INSTALLATION

Installation of the gas system shall be in conformance with the manufacturer's recommendations and applicable provisions of NFPA 54, AGA-01, and as indicated. Pipe cutting shall be done without damage to the pipe. Unless otherwise authorized, cutting shall be done by an approved type of mechanical cutter. Wheel cutters shall be used where practicable.

3.3.1 Metallic Piping Installation

Changes in direction of piping shall be made with fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Aluminum alloy pipe shall not be used in exterior locations or underground.

3.3.2 Metallic Tubing Installation

Metallic tubing shall be installed using gas tubing fittings approved by the tubing manufacturer. Branch connections shall be made with tees. All tubing end preparation shall be made with tools designed for the purpose. Aluminum alloy tubing shall not be used in exterior locations or underground.

3.3.3 Concealed Piping in Buildings

When installing piping which is to be concealed, unions, tubing fittings, running threads, right- and left-hand couplings, bushings, and swing joints made by combinations of fittings shall not be used.

3.3.4 Aboveground Piping

Aboveground piping shall be run as straight as practicable along the alignment indicated and with a minimum of joints. Piping shall be separately supported. Exposed horizontal piping shall not be installed farther than 6 inches from nearest parallel wall in laundry areas where clothes hanging could be attempted.

3.3.5 Final Gas Connections

Unless otherwise specified herein, final connections shall be made with rigid metallic pipe and fittings. Provide accessible gas shutoff valve and coupling for each gas equipment item.

3.4 PIPE JOINTS

Pipe joints shall be designed and installed to effectively sustain the longitudinal pull-out forces caused by contraction of the piping or superimposed loads.

3.4.1 Threaded Metallic Joints

Threaded joints in metallic pipe shall have tapered threads evenly cut and shall be made with UL approved graphite joint sealing compound for gas service or tetrafluoroethylene tape applied to the male threads only. Threaded joints up to 1-1/2 inches in diameter may be made with approved tetrafluoroethylene tape. Threaded joints up to 2 inches in diameter may be made with approved joint sealing compound. After cutting and before threading, pipe shall be reamed and burrs shall be removed. Caulking of threaded joints to stop or prevent leaks shall not be permitted.

3.4.2 Welded Metallic Joints

Beveling, alignment, heat treatment, and inspection of welds shall conform to ASME B31.2. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected adversely. Electrodes that have been wetted or have lost any of their coating shall not be used.

3.4.3 Flared Metallic Tubing Joints

Flared joints in metallic tubing shall be made with special tools recommended by the tubing manufacturer. Flared joints shall be used only in systems constructed from nonferrous pipe and tubing, when experience or tests have demonstrated that the joint is suitable for the conditions, and when adequate provisions are made in the design to prevent separation of the joints. Metallic ball sleeve compression-type tubing fittings shall not be used for tubing joints.

3.4.4 Solder or Brazed Joints

Joints in metallic tubing and fittings shall be made with materials and procedures recommended by the tubing supplier. Joints shall be brazed with material having a melting point above 1000 degrees F. Brazing alloys shall not contain phosphorous.

3.5 PIPE SLEEVES

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall not be installed in structural members except where indicated or approved. All rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective wall, floor or roof, and shall be cut flush with each surface, except in mechanical room floors not located on grade where clamping flanges or riser pipe clamps are used. Unless otherwise indicated, sleeves shall be large enough to provide a minimum clearance of 1/4 inch all around the pipe. Sleeves in bearing walls, waterproofing membrane floors, and wet areas shall be steel pipe. Sleeves in nonbearing walls, floors, or ceilings may be steel pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic. For penetrations of fire walls, fire partitions and floors which are not on grade, the annular space between the pipe and sleeve shall be sealed with firestopping material and sealant that meet the requirement of Section 07270 - FIRESTOPPING.

3.6 PIPES PENETRATING WATERPROOFING MEMBRANES

Pipes penetrating waterproofing membranes shall be installed as specified in Section 15405 - PLUMBING, HOSPITAL.

3.7 FIRE SEAL

Penetrations of fire rated partitions, walls and floors shall be in accordance with Section 07270 - FIRESTOPPING.

3.8 ESCUTCHEONS

Escutcheons shall be provided for all finished surfaces where gas piping passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms.

3.9 SPECIAL REQUIREMENTS

Drips, grading of the lines, freeze protection, and branch outlet locations shall be as shown and shall conform to the requirements of NFPA 54.

3.10 BUILDING STRUCTURE

Building structure shall not be weakened by the installation of any gas piping. Beams or joists shall not be cut or notched.

3.11 PIPING SYSTEM SUPPORTS

Gas piping systems in buildings shall be supported with pipe hooks, metal pipe straps, bands or hangers suitable for the size of piping or tubing. Gas piping system shall not be supported by other piping. Spacing of supports in gas piping and tubing installations shall conform to the requirements of NFPA 54. The selection and application of supports in gas piping and tubing installations shall conform to the requirements of MSS SP-69.

3.12 ELECTRICAL BONDING AND GROUNDING

A gas piping system within a building shall be electrically continuous and bonded to a grounding electrode as required by NFPA 70.

3.13 TESTING

Before any section of a gas piping system is put into service, it shall be carefully tested to assure that it is gastight. Prior to testing, the system shall be blown out, cleaned and cleared of all foreign material. Each joint shall be tested by means of an approved gas detector, soap and water, or an equivalent nonflammable solution. Testing shall be completed before any work is covered, enclosed, or concealed. All testing of piping systems shall be done with due regard for the safety of employees and the public during the test. Bulkheads, anchorage and bracing suitably designed to resist test pressures shall be installed if necessary. Oxygen shall not be used as a testing medium.

3.13.1 Purging

After testing is completed, and before connecting any appliances, all gas piping shall be fully purged. LPG piping tested using fuel gas with appliances connected does not require purging. Piping shall not be purged into the combustion chamber of an appliance. The open end of piping systems being purged shall not discharge into confined spaces or areas where there are ignition sources unless the safety precautions recommended in NFPA 54 are followed.

3.13.2 Labor, Materials and Equipment

All labor, materials and equipment necessary for conducting the testing and purging shall be furnished by the Contractor.

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SECTION 15565

HEATING SYSTEM; GAS-FIRED HEATERS

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN GAS ASSOCIATION LABORATORIES (AGAL)

AGAL-01 (1995; Supple Dec 95) Directory of Certified Appliances and Accessories

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.44 (1991; Z21.44a; Z21.44b) Gas-Fired Gravity and Fan Type Direct Vent Wall Furnaces

ANSI Z21.49 (1992; Z21.49a) Gas-Fired Gravity and Fan Type Vented Wall Furnaces

ANSI Z21.66 (1988; Z21.66a; Z21.66b) Automatic Vent Damper Devices for Use with Gas-Fired Appliances

ANSI Z83.4 (1991; Z83.4a) Direct Gas-Fired Make-Up Air Heaters

ANSI Z83.6 (1990; Z83.6a; Z83.6b) Gas-Fired Infrared Heaters

ANSI Z83.8 (1990; Z83.8a; Z83.8b) Gas Unit Heaters

ANSI Z83.9 (1990; Z83.9a) Gas Fired Duct Furnaces

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (1993; Rev 1) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54 (1992) National Fuel Gas Code

NFPA 211 (1992) Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances

UNDERWRITERS LABORATORIES (UL)

UL-06 (1995) Gas and Oil Equipment Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-01 Data

Heating System; FIO.

Spare parts data for each different item of materials and equipment specified, after approval of the detail drawings, and not later than 3 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

SD-04 Drawings

Heating System; GA.

Detail drawings consisting of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operation of the system. Detail drawings for space heating equipment, controls, associated equipment, and for piping and wiring. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-06 Instructions

Heating System; FIO.

Six complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and basic operating features. Six complete copies of maintenance instructions listing routine maintenance, possible breakdowns, repairs and troubleshooting guide. The instructions shall include simplified piping, wiring, and control diagrams for the system as installed.

SD-09 Reports

Testing, Adjusting, and Balancing; GA.

Test reports shall be submitted in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

1.3 GENERAL REQUIREMENTS

1.3.1 Nameplates

Each major component of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the equipment.

1.3.2 Equipment Guards

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts so located that any person may come in close proximity thereto shall be completely enclosed or guarded. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be guarded or covered with insulation of type specified for service.

1.3.3 Verification of Dimensions

The Contractor shall become thoroughly familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from weather, humidity and temperature variations, dirt and dust, or other contaminants.

PART 2 - PRODUCTS

2.1 STANDARD PRODUCTS

Material and equipment shall be standard products of a manufacturer regularly engaged in manufacturing of the products. Equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

2.2 ELECTRICAL WORK

Electrical motor driven equipment shall be provided complete with motors, motor starters, and controls. Motors shall conform to NEMA MG 1. Electrical equipment and wiring shall be in accordance with Section 16415 - ELECTRICAL WORK, INTERIOR. Electrical characteristics shall be as specified or indicated. Unless otherwise indicated motors of 745.7 W (1 Hp) and above shall be high efficiency type. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control specified. Each motor shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.

2.3 HEATERS

Heaters shall be equipped for and adjusted to burn natural gas. Each heater shall be provided with a gas pressure regulator that will satisfactorily limit the main gas burner supply pressure. Heaters shall have an intermittent or interrupted electrically ignited pilot or a direct electric ignition system. Safety controls shall conform to the ANSI standard specified for each heater. Mounting brackets and hardware shall be furnished by the heater manufacturer and shall be factory finished to match the supported equipment.

2.3.1 Gas Fired Furnace

Furnace shall be in accordance with ANSI Z83.9. Furnace shall be power-vented type. Furnace shall have automatic ignition. Furnace shall employ metered combustion air with enclosed draft diverter (no open flue collar). Furnace heat exchangers shall be aluminum clad steel or stainless steel. Furnace shall have minimum steady state efficiency of 80 percent at maximum rated capacity and 75 percent at minimum rated capacity that is provided and allowed by the controls. Furnace shall be provided with a discharge air thermostat which controls the unit's burner.

2.4 THERMOSTATS

Thermostats shall be the adjustable electric or electronic type. Control wiring required to complete the space temperature control system shall be included. Thermostats shall have a 2 degree C (3 degree F) differential and a set point range of 4 to 24 degree C (40 to 75 degrees F). Thermostats shall be the single stage type.

2.5 VENT PIPING

Vent piping shall conform to the requirements of NFPA 54.

2.6 FACTORY FINISHES

Equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish.

PART 3 - EXECUTION

3.1 INSTALLATION

Equipment shall be installed as indicated and in accordance with the recommendations of the equipment manufacturer and the listing agency, except as otherwise specified.

3.1.1 Heating Equipment

Heaters shall be installed with clearance to combustibles complying with minimum distances as determined by AGAL-01, UL-06 and as indicated on each heater approval and listing plate. Heaters shall be independently supported from the building structure as indicated and shall not rely on support from suspended ceiling systems.

3.1.2 Vents

Vent dampers, piping and structural penetrations shall be located as indicated. Vent damper installation shall conform to ANSI Z21.66. Vent pipes, where not connected to a masonry chimney conforming to NFPA 211, shall extend through the roof or an outside wall and shall terminate, in compliance with NFPA 54. Vents passing through waterproof membranes shall be provided with the necessary flashings to obtain waterproof installations.

3.1.3 Gas Piping

Gas piping shall be connected as indicated and shall comply with the applicable requirements at Section 15488 - GAS PIPING SYSTEMS.

3.2 TESTING, ADJUSTING, AND BALANCING

Testing, adjusting, and balancing shall be as specified in Section 15990 - TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

3.3 Training

The Contractor shall conduct a training course for the maintenance and operating staff. The training period of 4 hours normal working time shall start after the system is functionally complete but before the final acceptance tests. The training shall include all of the items contained in the operating and maintenance instructions as well as demonstrations of routine maintenance operations. The Contracting Officer shall be given at least two weeks advance notice of such training.

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SECTION 15653

AIR-CONDITIONING SYSTEM (UNITARY TYPE)

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 270	(1984) Sound Rating of Outdoor Unitary Equipment
ARI 410	(1991) Forced-Circulation Air-Cooling and Air-Heating Coils
ARI 495	(1993) Refrigerant Liquid Receivers
ARI 700	(1993) Specifications for Fluorocarbon and Other Refrigerants
ARI 710	(1986) Liquid-Line Driers
ARI 720	(1988) Refrigerant Access Valves and Hose Connectors
ARI 750	(1987) Thermostatic Refrigerant Expansion Valves
ARI 760	(1987) Solenoid Valves for Use with Volatile Refrigerants

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A13.1	(1981; R 1993) Scheme for the Identification of Piping Systems
ANSI S1.13	(1971; R 1986) Methods for the Measurement of Sound Pressure Levels

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47	(1990) Ferritic Malleable Iron Castings
ASTM A 48	(1994a) Gray Iron Castings
ASTM A 53	(1995a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 106	(1994) Seamless Carbon Steel Pipe for High-Temperature Service

ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	(1996) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 181	(1995b) Forgings, Carbon Steel, for General-Purpose Piping
ASTM A 183	(1983; R 1990) Carbon Steel Track Bolts and Nuts
ASTM A 193	(1996) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 234	(1996) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 334	(1991) Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service
ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM A 653	(1995) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 733	(1993) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM B 32	(1995b) Solder Metal
ASTM B 62	(1993) Composition Bronze or Ounce Metal Castings
ASTM B 75	(1993) Seamless Copper Tube
ASTM B 88	(1993a) Seamless Copper Water Tube
ASTM B 117	(1994) Operating Salt Spray (Fog) Testing Apparatus
ASTM B 280	(1993a) Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B 650	(1995) Electrodeposited Engineering Chromium Coatings of Ferrous Substrates
ASTM C 67	(1994) Sampling and Testing Brick and Structural Clay Tile
ASTM C 534	(1994) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

ASTM C 916	(1985; R 1990) Adhesives for Duct Thermal Insulation
ASTM C 1071	(1991) Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material)
ASTM D 520	(1984; R 1989) Zinc Dust Pigment
ASTM D 596	(1991) Reporting Results of Analysis of Water
ASTM D 1384	(1994) Corrosion Test for Engine Coolants in Glassware
ASTM D 1784	(1992) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2000	(1995) Rubber Products in Automotive Applications
ASTM D 3308	(1991a) PTFE Resin Skived Tape
ASTM E 84	(1994) Surface Burning Characteristics of Building Materials
ASTM E 437	(1992) Industrial Wire Cloth and Screens (Square Opening Series)
ASTM F 104	(1993) Nonmetallic Gasket Materials
ASTM F 872	(1984; R 1990) Filter Units, Air Conditioning: Viscous-Impingement Type, Cleanable
AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)	
ASHRAE 15	(1994) Safety Code for Mechanical Refrigeration
ASHRAE 34	(1994) Number Designation and Safety Classification of Refrigerants
ASHRAE 52.1	(1992) Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter
ASHRAE 64	(1989) Methods of Testing Remote Mechanical-Draft Evaporative Refrigerant Condensers
ASHRAE 127	(1988) Method of Testing for Rating Computer and Data Processing Room Unitary Air-Conditioners
AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)	
ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)

ASME B16.5	(1988; Errata Oct 88; B16.5a) Pipe Flanges and Flanged Fittings
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1991) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1989) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.39	(1986; R 1994) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B31.1	(1992; B31.1a; B31.1b; B31.1c) Power Piping
ASME B31.5	(1992; B31.5a) Refrigeration Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPV VIII Div 1	(1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME BPV IX	(1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME PTC 23	(1986; Addenda 1992, R 1992) Atmospheric Water Cooling Equipment
AMERICAN WATER WORKS ASSOCIATION (AWWA)	
AWWA C606	(1987) Grooved and Shouldered Joints
AMERICAN WELDING SOCIETY (AWS)	
AWS-01	(1991) Brazing Handbook
AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
AWS D1.1	(1994) Structural Welding Code - Steel
ASSOCIATION OF HOME APPLIANCE MANUFACTURERS (AHAM)	
AHAM-01	(1994) Directory of Certified Room Air Conditioners

CALIFORNIA REDWOOD ASSOCIATION (CRA)

CRA-01 (1992) Standard Specifications for Grades of
California Redwood Lumber

COOLING TOWER INSTITUTE (CTI)

CTI ACT-105 (1990) Acceptance Test Code for Water Cooling
Towers

CTI Std-103 (1986) The Design of Cooling Towers with Redwood
Lumber

CTI Std-111 (1986) Gear Speed Reducers

CTI Std-114 (1986) Specifications for the Design of Cooling
Towers with Douglas Fir Lumber

CTI Std-134 (1985) Plywood for Use in Cooling Towers

CTI Std-137 (1988) Fiberglass Pultruded Structural Products
for Use in Cooling Towers

CTI WMS-112 (1986) Pressure Preservative Treatment of Lumber

EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA)

EJMA-01 (1993) EJMA Standards

HYDRAULIC INSTITUTE (HI)

HI-01 (1983) Standards for Centrifugal, Rotary and
Reciprocating Pumps

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25 (1993) Standard Marking System for Valves,
Fittings, Flanges and Unions

MSS SP-58 (1993) Pipe Hangers and Supports - Materials,
Design and Manufacture

MSS SP-67 (1990) Butterfly Valves

MSS SP-69 (1991) Pipe Hangers and Supports - Selection and
Application

MSS SP-70 (1990) Cast Iron Gate Valves, Flanged and
Threaded Ends

MSS SP-71 (1990) Cast Iron Swing Check Valves, Flanges and
Threaded Ends

MSS SP-72 (1992) Ball Valves with Flanged or Butt-Welding
Ends

MSS SP-78	(1987; R 1992) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends
MSS SP-110	(1992) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 6	(1993) Enclosures for Industrial Control and Systems
NEMA MG 1	(1993; Rev 1-1993) Motors and Generators
NEMA MG 2	(1989; Rev 1) Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(1992) National Fuel Gas Code
NFPA 70	(1996) National Electrical Code
NFPA 90A	(1993) Installation of Air Conditioning and Ventilating Systems
NFPA 214	(1992) Water-Cooling Towers
NFPA 255	(1990) Method of Test of Surface Burning Characteristics of Building Materials

NORTH AMERICAN INSULATION MANUFACTURERS ASSOCIATION (NAIMA)

NAIMA-01	(1993) Fibrous Glass Duct Construction Standards
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SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)

SMACNA-05	(1992) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
SMACNA-06	(1995) HVAC Duct Construction Standards - Metal and Flexible
SMACNA-10	(1985) HVAC Air Duct Leakage Test Manual

UNDERWRITERS LABORATORIES (UL)

UL-01	(1996; Supple) Building Materials Directory
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UL-03	(1996) Electrical Construction Materials Directory
UL-05	(1996; Supple) Fire Resistance Directory
UL 181	(1996; Rev Oct 1996) Factory-Made Air Ducts and Air Connectors
UL 207	(1993; Rev thru Mar 1995) Refrigerant-Containing Components and Accessories, Nonelectrical
UL 214	(1993) Tests for Flame-Propagation of Fabrics and Films
UL 484	(1993; Rev thru Aug 1996) Room Air Conditioners
UL 555	(1995) Fire Dampers
UL 586	(1990; Rev Apr 1995) High Efficiency, Particulate, Air Filter Units
UL 723	(1996) Test for Surface Burning Characteristics of Building Materials
UL 900	(1994) Test Performance of Air Filter Units
UL 1995	(1995) Heating and Cooling Equipment

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA-01	(1995; Supple Nos. 1, 2, and 3) Western Lumber Grading Rules 95
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1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-01 Data

Air-Conditioning/Heat Pump System; FIO.

Manufacturer's standard catalog data, prior to the purchase or installation of a particular component, shall be highlighted to show brand name, model number, size, options, performance charts and curves, etc. in sufficient detail to demonstrate compliance with contract requirements. Data shall be submitted for each specified component. Data shall include manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, vibration isolator literature shall be included containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations.

Spare Parts Data; FIO.

Spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 1 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

SD-04 Drawings

Air-Conditioning/Heat Pump System; GA.

Drawings shall provide adequate detail to demonstrate compliance with contract requirements. Drawings shall consist of:

- (1) Equipment layouts which identify assembly and installation details.
- (2) Plans and elevations which identify clearances required for maintenance and operation.
- (3) Wiring diagrams which identify each component individually and interconnected or interlocked relationships between components.
- (4) Foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for equipment indicated or required to have concrete foundations.
- (5) Details, if piping and equipment are to be supported other than as indicated, which include loadings and type of frames, brackets, stanchions, or other supports.
- (6) Automatic temperature control diagrams and control sequences.
- (7) Installation details which includes the amount of factory set superheat and corresponding refrigerant pressure/temperature.

SD-06 Instructions

Framed Instructions; FIO.

Framed instructions for posting, at least 2 weeks prior to construction completion.

SD-07 Schedules

Tests; FIO.

A letter, at least 10 working days in advance of each tests, advising the Contracting Officer of the test. Individual letters shall be submitted for the condenser water system, refrigerant system, ductwork leak tests, cooling tower tests, condenser water quality tests, and the system performance tests. Each letter shall identify the date, time, and location for each test.

SD-09 Reports

Tests; GA.

Six copies of each test containing the information described below in bound 8-1/2 by 11 inch booklets. Individual reports shall be submitted for the condenser water system, refrigerant system, ductwork leak tests, and the cooling tower tests.

- (1) The date the tests were performed.
- (2) A list of equipment used, with calibration certifications.
- (3) Initial test summaries.
- (4) Repairs/adjustments performed.
- (5) Final test results.

System Performance Tests; GA.

Six copies of the report shall be provided in bound 8-1/2 by 11 inch booklets. The report shall document compliance with the specified performance criteria upon completion and testing of the system. The report shall indicate the number of days covered by the tests and any conclusions as to the adequacy of the system. The report shall also include the following information and shall be taken at least three different times at outside dry-bulb temperatures that are at least 5 degrees F apart:

- (1) Date and outside weather conditions.
- (2) The load on the system based on the following:
 - (a) The refrigerant used in the system.
 - (b) Condensing temperature and pressure.
 - (c) Suction temperature and pressure.
 - (d) Ambient, condensing and coolant temperatures
 - (e) Running current, voltage and proper phase sequence for each phase of all motors.
- (3) The actual on-site setting of operating and safety controls.
- (4) Thermostatic expansion valve superheat - value as determined by field test
- (5) Subcooling
- (6) High and low refrigerant temperature switch set-points
- (7) Low oil pressure switch set-point
- (8) Defrost system timer and thermostat set-points
- (9) Moisture content
- (10) Capacity control set-points
- (11) Field data and adjustments which affect unit performance and energy consumption.

(12) Field adjustments and settings which were not permanently marked as an integral part of a device.

Inspections; FIO.

Test report, at the completion of one year of service, in bound 8-1/2 by 11 inch booklets. The report shall identify the condition of the cooling tower and condenser. The report shall also include a comparison of the condition of the cooling tower and condenser with the manufacturer's recommended operating conditions.

SD-13 Certificates

Air-Conditioning/Heat Pump System; FIO.

Where the system, components, or equipment are specified to comply with requirements of ARI, ASHRAE, ASME, or UL, proof of such compliance shall be provided. The label or listing of the specified agency shall be acceptable evidence. In lieu of the label or listing, a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency may be submitted. When performance requirements of this project's drawings and specifications vary from standard ARI rating conditions, computer printouts, catalog, or other application data certified by ARI or a nationally recognized laboratory as described above shall be included. If ARI does not have a current certification program that encompasses such application data, the manufacturer may self certify that his application data complies with project performance requirements in accordance with the specified test standards.

Service Organizations; FIO.

A certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. The service organizations shall be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

SD-19 Operation and Maintenance Manuals

Operation Manual; FIO.

Six complete copies of an operation manual in bound 8-1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, and shutdown. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.

Maintenance Manual; FIO.

Six complete copies of maintenance manual in bound 8-1/2 by 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

1.3 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather and contamination. Proper protection and care of all material before, during, and after installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.4 PROJECT/SITE CONDITIONS

1.4.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.4.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions. Equipment, ductwork, and piping arrangements shall fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance.

PART 2 - PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record shall be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations.

2.2 NAMEPLATES

Major equipment including compressors, condensers, receivers, heat exchanges, fans, cooling towers, pumps and motors shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates shall be durable and legible throughout equipment life and made of anodized aluminum or stainless steel. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

2.3 ELECTRICAL WORK

Electrical equipment, motors, motor efficiencies, and wiring shall be in accordance with Section 16415 - ELECTRICAL WORK, INTERIOR. Electrical motor driven equipment specified shall be provided complete with motors, motor starters, and controls. Electrical characteristics shall be as shown, and unless otherwise indicated, all motors of 1 horsepower and above with open, dripproof, totally enclosed, or explosion proof fan cooled enclosures, shall be high efficiency type. Field wiring shall be in accordance with manufacturer's instructions. Each motor shall conform to NEMA MG 1 and NEMA MG 2 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Motors shall be continuous duty with the enclosure specified. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Motors shall be furnished with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motors shall be sized for the applicable loads. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of enclosure. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.

2.4 MISCELLANEOUS MATERIALS

2.4.1 Unicellular Plastic Foam

Unicellular plastic foam shall be in accordance with ASTM C 534, Form T, except that D-Factor shall not exceed 0.28 at 75 degrees F mean temperature.

2.4.2 Bird Screen

Screen shall be in accordance with ASTM E 437, Type 1, Class 1, 2 by 2 mesh, 0.063 inch diameter aluminum wire or 0.031 inch diameter stainless steel wire.

2.5 UNITARY EQUIPMENT, PACKAGE SYSTEM

Unit shall be an air-cooled factory assembled, weatherproof packaged unit as indicated. Unit shall be the air-conditioning type conforming to applicable Underwriters Laboratories (UL) standards including UL 1995. Unit shall be rated in accordance with ARI 210/240. Unit shall be provided with equipment as specified in paragraph "System Components". Evaporator or supply fans shall be double-width, double inlet, forward curved, backward inclined, or airfoil blade, centrifugal scroll type. Motors shall have dripproof enclosures. Condenser fans shall be manufacturer's standard for the unit specified and may be either propeller or centrifugal scroll type. Unit shall be provided with a factory operating charge of refrigerant and oil or a holding charge. Unit shipped with a holding charge shall be field charged with refrigerant and oil in accordance with manufacturer's recommendations. Outdoor unit shall produce a maximum ARI sound rating of 10 bels in accordance with ARI 270.

2.5.1 Air-to-Refrigerant Coils

Air-to-refrigerant coils shall have nonferrous tubes of 3/8 inch minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Casing shall be galvanized steel or aluminum. Contact of dissimilar metals shall be avoided. Coils shall be tested in accordance with ASHRAE 15 at the factory and be suitable for the working pressure of the installed system. Each coil shall be dehydrated and sealed after testing and prior to evaluation and charging. Each unit shall be provided with a factory operating charge of refrigerant and oil or a holding charge. Unit shipped with a holding charge shall be field charged. Separate expansion devices shall be provided for each compressor circuit.

2.5.2 Compressor

Compressor shall be direct drive, semi-hermetic or hermetic reciprocating, or scroll type capable of operating at partial load conditions. Compressor shall be capable of continuous operation down to the lowest step of unloading as specified. If standard with the manufacturer, two or more compressors may be used in lieu of a single compressor with unloading capabilities, in which case the compressors shall operate in sequence, and each compressor shall have an independent refrigeration circuit through the condenser and evaporator. Compressors shall start in the unloaded position. Each compressor shall be provided with vibration isolators, crankcase heater, thermal overloads, high and low pressure safety cutoffs and protection against short cycling.

2.5.3 Refrigeration Circuit

Refrigerant containing components shall comply with ASHRAE 15 and be factory tested, cleaned, dehydrated, charged, and sealed. Refrigerant charging valves and connections, and pumpdown valves shall be provided for each circuit. Filter-drier shall be provided in each liquid line and be reversible-flow type. Refrigerant flow control devices shall be an adjustable superheat thermostatic expansion valve with external equalizer matched to coil, capillary or thermostatic control, and a pilot solenoid controlled, leak-tight, four-way refrigerant flow reversing valve.

2.5.4 Unit Controls

Unit shall be internally prewired with a 24 or 120 volt control circuit powered by an internal transformer. Terminal blocks shall be provided for power wiring and external control wiring. Unit shall have cutoffs for high and low pressure, and low oil pressure for compressors with positive displacement oil pumps, supply fan failure and safety interlocks on all service panels. Adjustable-cycle timers shall prevent short-cycling. Multiple compressors shall be staged by means of a time delay. Unit shall be internally protected by fuses or a circuit breaker in accordance with UL 1995. Low cost cooling shall be made possible by means of a control circuit which will modulate dampers to provide 100 percent outside air while locking out compressors.

2.6 SYSTEM COMPONENTS

2.6.1 Refrigerant and Oil

Refrigerant shall be one of the fluorocarbon gases. Refrigerants shall have number designations and safety classifications in accordance with ASHRAE 34. Refrigerants shall meet the requirements of ARI 700 as a minimum. Refrigerants shall have an Ozone Depletion Potential (ODP) of less than or equal to 0.05. Contractor shall provide and install a complete charge of refrigerant for the installed system as recommended by the manufacturer. Except for factory sealed units, two complete charges of lubricating oil for each compressor crankcase shall be furnished. One charge shall be used during the system performance testing period. Following the satisfactory completion of the performance testing, the oil shall be drained and replaced with a second charge. Lubricating oil shall be of a type and grade recommended by the manufacturer for each compressor. Where color leak indicator dye is incorporated, charge shall be in accordance with manufacturer's recommendation.

2.6.2 Fans

Fan wheel shafts shall be supported by either maintenance-accessible lubricated antifriction block-type bearings, or permanently lubricated ball bearings. Unit fans shall be selected to produce the cfm required at the fan total pressure. Motor starters, if applicable, shall be magnetic across-the-line type with a drip-proof enclosure. Thermal overload protection shall be of the manual or automatic-reset type. Fan wheels or propellers shall be constructed of aluminum or galvanized steel. Centrifugal fan wheel housings shall be of galvanized steel, and both centrifugal and propeller fan casings shall be constructed of aluminum or galvanized steel. Steel elements of fans, except fan shafts, shall be hot-dipped galvanized after fabrication or fabricated of mill galvanized steel. Mill-galvanized steel surfaces and edges damaged or cut during fabrication by forming, punching, drilling, welding, or cutting shall be recoated with an approved zinc-rich compound. Fan wheels or propellers shall be statically and dynamically balanced. Direct-drive fan motors shall be of the multiple-speed variety. The sheave size shall be selected so that the fan speed at the approximate midpoint of the sheave adjustment will produce the specified air quantity. Centrifugal scroll-type fans shall be provided with streamlined orifice inlet and V-belt drive. Each drive will be independent of any other drive. Propeller fans shall be direct-drive drive type with fixed pitch blades. V-belt driven fans shall be mounted on a corrosion protected drive shaft supported by either maintenance-accessible lubricated antifriction block-type bearings, or permanently lubricated ball bearings. Each drive will be independent of any other drive. Drive bearings shall be protected with water slingers or shields. V-belt drives shall be fitted with guards where exposed to contact by personnel and fixed pitch sheaves.

2.6.3 Primary Heating

2.6.3.1 Gas Furnace Unit

Gas fired furnace section shall be integral to the air handling unit system and shall be as specified in Section 15565 - HEATING SYSTEM; GAS-FIRED HEATERS.

2.6.4 Pressure Vessels

Pressure vessels shall conform to ASME BPV VIII Div 1 or UL 207, as applicable for maximum and minimum pressure or temperature encountered. Where referenced publications do not apply, pressure components shall be tested at 1-1/2 times design working pressure. Refrigerant wetted carbon steel surfaces shall be pickled or abrasive blasted free of mill scale, cleaned, dried, charged, and sealed.

2.6.5 Internal Dampers

Dampers shall be parallel blade type with renewable blade seals and be integral to the unitary unit. Damper provisions shall be provided for each outside air intake, exhaust, economizer, and mixing boxes. Dampers shall automatic modulation and operate as specified.

2.6.6 Cabinet Construction

Casings for the specified unitary equipment shall be constructed of galvanized steel or aluminum sheet metal and galvanized or aluminum structural members. Minimum thickness of single wall exterior surfaces shall be 18 gauge galvanized steel or .071 inch thick aluminum on units with a capacity above 20 tons and 20 gauge galvanized steel or 0.064 inch thick aluminum on units with a capacity less than 20 tons. Casing shall be fitted with lifting provisions, access panels or doors, fan vibration isolators, electrical control panel, corrosion-resistant components, structural support members, insulated condensate drip pan and drain, and internal insulation in the cold section of the casing. Where double-wall insulated construction is proposed, minimum exterior galvanized sheet metal thickness shall be 20 gauge. Provisions to permit replacement of major unit components shall be incorporated. Penetrations of cabinet surfaces, including the floor, shall be sealed. Unit shall be fitted with a drain pan which extends under all areas where water may accumulate. Drain pan shall be fabricated from Type 300 stainless steel, galvanized steel with protective coating as required, or an approved plastic material. Pan insulation shall be water impervious. Extent and effectiveness of the insulation of unit air containment surfaces shall prevent, within limits of the specified insulation, heat transfer between the unit exterior and ambient air, heat transfer between the two conditioned air streams, and condensation on surfaces. Insulation shall conform to ASTM C 1071. Paint and finishes shall comply with the requirements specified in paragraph "Factory Coating".

2.6.6.1 Outdoor Cabinet

Outdoor cabinets shall be suitable for outdoor service with a weathertight, insulated and corrosion-protected structure. Cabinets constructed exclusively for indoor service which have been modified for outdoor service are not acceptable.

2.7 INSULATION

2.7.1 Factory Installed Insulation

Factory applied insulation shall be as specified for the equipment to be insulated except that refrigerant suction lines shall be insulated with

unicellular plastic foam. Insulation shall comply with the fire hazard rating specified in Section 15250 - THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.8 TEMPERATURE CONTROLS

Temperature controls shall be fully coordinated with and integrated into the existing air-conditioning system.

2.9 REFRIGERANT PIPING

Refrigerant piping, valves, fittings, and accessories shall conform to the requirements of ASHRAE 15 and ASME B31.5.

PART 3 - EXECUTION

3.1 INSTALLATION

Work shall be performed in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements. Where equipment is specified to conform to the requirements of ASME BPV VIII Div 1 and ASME BPV IX, the design, fabrication, and installation of the system shall conform to ASME BPV VIII Div 1 and ASME BPV IX.

3.1.1 Equipment

Refrigeration equipment and the installation thereof shall conform to ASHRAE 15. Necessary supports shall be provided for all equipment, appurtenances, and pipe as required, including frames or supports for compressors, pumps, cooling towers, condensers, and similar items. Compressors shall be isolated from the building structure. If mechanical vibration isolators are not provided, vibration absorbing foundations shall be provided. Each foundation shall include isolation units consisting of machine and floor or foundation fastenings, together with intermediate isolation material. In lieu of concrete pad foundation, concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. Concrete pedestal block shall be of mass not less than three times the combined pump, motor, and base weights. Isolators shall be selected and sized based on load-bearing requirements and the lowest frequency of vibration to be isolated. Lines connected to pumps mounted on pedestal blocks shall be provided with flexible connectors. Foundation drawings, bolt-setting information, and foundation bolts shall be furnished prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Equipment shall be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions.

3.1.1.1 Fire-Rated Penetrations

Penetration of fire-rated walls, partitions, and floors shall be sealed as specified in Section 07270 - FIRESTOPPING.

3.1.1.2 Escutcheons

Finished surfaces where exposed piping, bare or insulated, pass through floors, walls, or ceilings, except in boiler, utility, or equipment rooms, shall be provided with escutcheons. Where sleeves project slightly from

floors, special deep-type escutcheons shall be used. Escutcheon shall be secured to pipe or pipe covering.

3.1.2 Access Panels

Access panels shall be provided for all concealed valves vents, controls, and items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in Section 05500 - MISCELLANEOUS METALS.

3.1.3 Framed Instructions

Framed instructions shall be framed under glass or laminated plastic and be posted where directed. Instructions shall include equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions shall include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The instructions shall be posted before acceptance testing of the system.

3.2 TESTS

Tests shall be conducted in the presence of the Contracting Officer. Utilities for testing shall be provided as specified in the SPECIAL CONTRACT REQUIREMENTS. Water and electricity required for the tests will be furnished by the Government. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor. The services of a qualified technician shall be provided as required to perform all tests and procedures indicated herein. Field tests shall be coordinated with Section 15990 - TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

3.3 CLEANING AND ADJUSTING

3.3.1 Equipment

Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. System shall be maintained in this clean condition until final acceptance. Bearings shall be lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed.

3.3.2 Testing, Adjusting, and Balancing

Testing, adjusting, and balancing shall be as specified in Section 15990 - TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS.

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SECTION 15895

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 210	(1985) Laboratory Methods of Testing Fans for Rating
AMCA 300	(1996) Reverberant Room Method for Sound Testing of Fans

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABEMA)

ABEMA 9	(1990) Load Ratings and Fatigue Life for Ball Bearings
ABEMA 11	(1990) Load Ratings and Fatigue Life for Roller Bearings

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S12.32	(1990) Precision Methods for the Determination of Sound Power Levels of Discrete-Frequency and Narrow-Band Noise Sources in Reverberation Rooms
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 916	(1985; R 1990) Adhesives for Duct Thermal Insulation
ASTM C 1071	(1991) Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material)
ASTM D 3359	(1995) Measuring Adhesion by Tape Test
ASTM E 84	(1994) Surface Burning Characteristics of Building Materials
ASTM E 437	(1992) Industrial Wire Cloth and Screens (Square Opening Series)

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

- | | |
|-------------|--|
| ASHRAE 52.1 | (1992) Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter |
| ASHRAE 68 | (1986) Laboratory Method of Testing In-Duct Sound Power Measurement Procedures for Fans |
| ASHRAE 70 | (1991) Method of Testing Rating the Performance of Air Outlets and Inlets |

COMMERCIAL ITEM DESCRIPTIONS (CID)

- | | |
|--------------|---|
| CID A-A-1419 | (Rev D) Filter Element, Air Conditioning (Viscous-Impingement and Dry Types, Replaceable) |
|--------------|---|

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- | | |
|----------|---|
| NFPA 70 | (1996) National Electrical Code |
| NFPA 90A | (1993) Installation of Air Conditioning and Ventilating Systems |

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

- | | |
|-----------|---|
| SMACNA-01 | (1975) Accepted Industry Practice for Industrial Duct Construction |
| SMACNA-05 | (1992) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems |
| SMACNA-06 | (1995) HVAC Duct Construction Standards - Metal and Flexible |
| SMACNA-10 | (1985) HVAC Air Duct Leakage Test Manual |

UNDERWRITERS LABORATORIES (UL)

- | | |
|---------|---|
| UL-05 | (1996; Supple) Fire Resistance Directory (3 Vol.) |
| UL 181 | (1996; Rev Oct 1996) Factory-Made Air Ducts and Air Connectors |
| UL 555 | (1995) Fire Dampers |
| UL 705 | (1994; Rev thru Mar 1996) Power Ventilators |
| UL 723 | (1993; Rev Apr 1994) Test for Surface Burning Characteristics of Building Materials |
| UL 900 | (1994) Test Performance of Air Filter Units |
| UL 1995 | (1995) Heating and Cooling Equipment |

1.2 COORDINATION OF TRADES

Ductwork, piping offsets, fittings, and accessories shall be furnished as required to provide a complete installation and to eliminate interference with other construction.

1.3 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-01 Data

Components and Equipment Data; FIO.

Manufacturer's catalog data shall be included with the detail drawings for the following items. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with contract requirements for the following:

- a. Piping Components
- b. Ductwork Components
- c. Air Systems Equipment
- d. Air Handling Units

SD-04 Drawings

Air Supply, Distribution, Ventilation, and Exhaust Equipment; FIO.

Drawings shall consist of equipment layout including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications; and piping layout showing the location of all guides and anchors, the load imposed on each support or anchor, and typical support details. Drawings shall include any information required to demonstrate that the system has been coordinated and will properly function as a unit and shall show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

SD-06 Instructions

Test Procedures; FIO.

Proposed test procedures for piping hydrostatic test, ductwork leak test, and performance tests of systems, at least 2 weeks prior to the start of related testing.

Welding Procedures; FIO.

A copy of qualified welding procedures, at least 2 weeks prior to the start of welding operations.

System Diagrams; GA.

Proposed diagrams, at least 2 weeks prior to start of related testing. System diagrams that show the layout of equipment, piping, and ductwork, and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system shall be framed under glass or laminated plastic. After approval, these items shall be posted where directed.

SD-19 Operation and Maintenance Manuals

Air Supply, Distribution, Ventilation, and Exhaust Manuals; GA.

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 2 weeks prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4 hour onsite response to a service call on an emergency basis.

PART 2 - PRODUCTS**2.1 STANDARD PRODUCTS**

Components and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years before bid opening. The 2-year experience shall include applications of components and equipment under similar circumstances and of similar size. The 2 years must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization.

2.2 ASBESTOS PROHIBITION

Asbestos and asbestos-containing products shall not be used.

2.3 NAMEPLATES

Equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.4 EQUIPMENT GUARDS AND ACCESS

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded according to OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified.

2.5 ELECTRICAL WORK

Electrical motor-driven equipment specified shall be provided complete with motor, motor starter, and controls. Unless otherwise specified, electric equipment, including wiring and motor efficiencies, shall be according to Section 16415 - ELECTRICAL WORK, INTERIOR. Electrical characteristics and enclosure type shall be as shown. Unless otherwise indicated, motors of 1 hp and above shall be high efficiency type. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary. Each motor shall be according to NEMA MG 1 and shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices, but not shown, shall be provided. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controller may be provided to accomplish the same function. Solid-state variable-speed controllers shall be utilized for motors rated 10 hp or less. Adjustable frequency drives shall be used for larger motors.

2.6 DUCTWORK COMPONENTS

2.6.1 Metal Ductwork

All aspects of metal ductwork construction, including all fittings and components, shall comply with SMACNA-06 unless otherwise specified. Elbows shall be radius type with a centerline radius of 1-1/2 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes may be used. Static pressure Class 1/2, 1, and 2 inch w.g. ductwork shall meet the requirements of Seal Class C. Class 3 through 10 inch shall meet the requirements of Seal Class A. Sealants shall conform to fire hazard classification specified in Section 15250 - THERMAL INSULATION FOR MECHANICAL SYSTEMS. Pressure sensitive tape shall not be used as a sealant. Spiral lock seam duct, and flat oval shall be made with duct sealant and locked with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA-06. The sealant shall be applied to the exposed male part of the fitting collar so that the sealer will be on the inside of the joint and fully protected by the metal of the duct fitting. One

brush coat of the sealant shall be applied over the outside of the joint to at least 2 inch band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar will not be acceptable. Outdoor air intake ducts and plenums shall be fabricated with watertight soldered or brazed joints and seams.

2.6.1.1 Transitions

Diverging air flow transitions shall be made with each side pitched out a maximum of 15 degrees, for an included angle of 30 degrees. Transitions for converging air flow shall be made with each side pitched in a maximum of 30 degrees, for an included angle of 60 degrees, or shall be as indicated. Factory-fabricated reducing fittings for systems using round duct sections when formed to the shape of the ASME short flow nozzle, need not comply with the maximum angles specified.

2.6.1.2 Insulated Nonmetallic Flexible Duct Runouts

Flexible duct runouts shall be used only where indicated. Runout length shall be as shown on the drawings, but shall in no case exceed 5 feet. Runouts shall be preinsulated, factory fabricated, and shall comply with NFPA 90A and UL 181. Either field or factory applied vapor barrier shall be provided. Where coil induction or high velocity units are supplied with vertical air inlets, a streamlined and vaned and mitered elbow transition piece shall be provided for connection to the flexible duct or hose. The last elbow to these units, other than the vertical air inlet type, shall be a die-stamped elbow and not a flexible connector. Insulated flexible connectors may be used as runouts. The insulated material and vapor barrier shall conform to the requirements of Section 15250 - THERMAL INSULATION FOR MECHANICAL SYSTEMS. The insulation material surface shall not be exposed to the air stream.

2.6.1.3 General Service Duct Connectors

A flexible duct connector approximately 6 inches in width shall be provided where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, the flexible material shall be secured by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, the flexible material locked to metal collars shall be installed using normal duct construction methods. The composite connector system shall comply with UL 214 and be classified as "flame-retarded fabrics" in UL-01.

2.6.2 Ductwork Accessories

2.6.2.1 Duct Access Doors

Access doors shall be provided in ductwork and plenums where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system, and unless otherwise shown, shall conform to SMACNA-06. Access doors shall be provided upstream and downstream of air flow measuring primaries and heating and cooling coils. Doors shall be minimum 15 x 18 inches, unless otherwise shown. Where duct size will not accommodate this size door, the doors shall be made as large as practicable. Doors 24 x 24 inches or larger

shall be provided with fasteners operable from both sides. Doors in insulated ducts shall be the insulated type.

2.6.2.2 Splitters and Manual Balancing Dampers

Splitters and manual balancing dampers shall be furnished with accessible operating mechanisms. Where operators occur in finished portions of the building, operators shall be chromium plated with all exposed edges rounded. Manual volume control dampers shall be operated by locking-type quadrant operators. Dampers and splitters shall be 2 gauges heavier than the duct in which installed. Unless otherwise indicated, multileaf dampers shall be opposed blade type with maximum blade width of 12 inches. Access doors or panels shall be provided for all concealed damper operators and locking setscrews. Unless otherwise indicated, the locking-type quadrant operators for dampers, when installed on ducts to be thermally insulated, shall be provided with stand-off mounting brackets, bases, or adapters to provide clearance between the duct surface and the operator not less than the thickness of the insulation. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer. Volume dampers shall be provided where indicated.

2.6.2.3 Air Deflectors and Branch Connections

Air deflectors shall be provided at duct mounted supply outlets, at takeoff or extension collars to supply outlets, at duct branch takeoff connections, and at 90 degree elbows, as well as at locations as indicated on the drawings or otherwise specified. Conical branch connections or 45 degree entry connections may be used in lieu of deflectors or extractors for branch connections. All air deflectors, except those installed in 90 degree elbows, shall be provided with an approved means of adjustment. Adjustment shall be made from easily accessible means inside the duct or from an adjustment with sturdy lock on the face of the duct. When installed on ducts to be thermally insulated, external adjustments shall be provided with stand-off mounting brackets, integral with the adjustment device, to provide clearance between the duct surface and the adjustment device not less than the thickness of the thermal insulation. Air deflectors shall be factory-fabricated units consisting of curved turning vanes or louver blades designed to provide uniform air distribution and change of direction with minimum turbulence or pressure loss. Air deflectors shall be factory or field assembled. Blade air deflectors, also called blade air extractors, shall be approved factory fabricated units consisting of equalizing grid and adjustable blade and lock. Adjustment shall be easily made from the face of the diffuser or by position adjustment and lock external to the duct. Stand-off brackets shall be provided on insulated ducts and are described herein. Fixed air deflectors, also called turning vanes, shall be provided in 90 degree elbows.

2.6.3 Duct Sleeves, Framed Prepared Openings, Closure Collars

2.6.3.1 Duct Sleeves

Duct sleeves shall be provided for round ducts 15 inches in diameter or less passing through floors, walls, ceilings, or roof, and installed during construction of the floor, wall, ceiling, or roof. Round ducts larger than 15 inches in diameter and square, rectangular, and oval ducts passing through floors, walls, ceilings, or roof shall be installed through framed prepared

openings. The Contractor shall be responsible for the proper size and location of sleeves and prepared openings. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Framed prepared openings shall be fabricated from 20 gauge galvanized steel, unless otherwise indicated. Where sleeves are installed in bearing walls or partitions, black steel pipe, ASTM A 53, Schedule 20 shall be used. Sleeve shall provide 1 inch clearance between the duct and the sleeve or 1 inch clearance between the insulation and the sleeve for insulated ducts.

2.6.3.2 Framed Prepared Openings

Openings shall have 1 inch clearance between the duct and the opening or 1 inch clearance between the insulation and the opening for insulated ducts.

2.6.3.3 Closure Collars

Collars shall be fabricated of galvanized sheet metal not less than 4 inches wide, unless otherwise indicated, and shall be installed on exposed ducts on each side of walls or floors where sleeves or prepared openings are provided. Collars shall be installed tight against surfaces. Collars shall fit snugly around the duct or insulation. Sharp edges of the collar around insulated duct shall be ground smooth to preclude tearing or puncturing the insulation covering or vapor barrier. Collars for round ducts 15 inches in diameter or less shall be fabricated from 20 gauge galvanized steel. Collars for round ducts larger than 15 inches and square, and rectangular ducts shall be fabricated from 18 gauge galvanized steel. Collars shall be installed with fasteners on maximum 6 inch centers, except that not less than 4 fasteners shall be used.

2.6.4 Sound Attenuation Equipment

a. Acoustical Duct Liner:

Acoustical duct lining shall be fibrous glass designed exclusively for lining ductwork and shall conform to the requirements of ASTM C 1071, Type I and II. Liner composition may be uniform density, graduated density, or dual density, as standard with the manufacturer. Lining shall be coated, not less than 1 inch thick. Where acoustical duct liner is used, liner or combination of liner and insulation applied to the exterior of the ductwork shall be the thermal equivalent of the insulation specified in Section 15250 - THERMAL INSULATION FOR MECHANICAL SYSTEMS. Duct sizes shown shall be increased to compensate for the thickness of the lining used. In lieu of sheet metal duct with field-applied acoustical lining, acoustically equivalent lengths of fibrous glass duct or factory fabricated double-walled internally insulated duct with perforated liner may be provided. Net insertion loss value, static pressure drop, and air flow velocity capacity data shall be certified by a nationally recognized independent acoustical laboratory.

2.6.5 Diffusers, Registers, and Grilles

Units shall be factory-fabricated of steel, corrosion-resistant steel, or aluminum and shall distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 50 fpm in occupied zone, or dead spots anywhere in the conditioned area. Outlets for diffusion, spread, throw, and noise level shall be as required for specified

performance. Performance shall be certified according to ASHRAE 70. Inlets and outlets shall be sound rated and certified according to ASHRAE 70. Sound power level shall be as indicated. Diffusers and registers shall be provided with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device will be acceptable. Volume dampers shall be opposed blade type for all diffusers and registers, except linear slot diffusers. Linear slot diffusers shall be provided with round or elliptical balancing dampers.

2.6.5.1 Diffusers

Diffuser types shall be as indicated. Ceiling mounted units shall be furnished with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Diffusers shall be provided with air deflectors of the type indicated. Air handling troffers or combination light and ceiling diffusers shall conform to the requirements of UL-03 for the interchangeable use as cooled or heated air supply diffusers or return air units. Ceiling mounted units shall be installed with rims tight against ceiling. Sponge rubber gaskets shall be provided between ceiling and surface mounted diffusers for air leakage control. Suitable trim shall be provided for flush mounted diffusers. Duct collar connecting the duct to diffuser shall be airtight and shall not interfere with volume controller. Return or exhaust units shall be similar to supply diffusers.

2.6.5.2 Registers and Grilles

Units shall be four-way directional-control type, except that return and exhaust registers may be fixed horizontal or vertical louver type similar in appearance to the supply register face. Registers shall be provided with sponge-rubber gasket between flanges and wall or ceiling. Wall supply registers shall be installed at least 6 inches below the ceiling unless otherwise indicated. Return and exhaust registers shall be located 6 inches above the floor unless otherwise indicated. Four-way directional control may be achieved by a grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Grilles shall be as specified for registers, without volume control damper.

2.6.6 Air Vents, Penthouses, and Goosenecks

Air vents, penthouses, and goosenecks shall be fabricated from galvanized steel sheets with galvanized structural shapes. Sheet metal thickness, reinforcement, and fabrication shall conform to SMACNA-06. Louver blades shall be accurately fitted and secured to frames. Edges of louver blades shall be folded or beaded for rigidity and baffled to exclude driving rain. Air vents, penthouses, and goosenecks shall be provided with bird screen.

2.6.7 Bird Screens and Frames

Bird screens shall conform to ASTM E 437, Type I, Class 1, 2 by 2 mesh, 0.063 inch diameter aluminum wire or 0.031 inch diameter stainless steel wire. Frames shall be removable type or stainless steel or extruded aluminum.

2.7 AIR SYSTEMS EQUIPMENT

2.7.1 Fans

Fans shall be tested and rated according to AMCA 210. Fans may be connected to the motors either directly or indirectly with V-belt drive. V-belt drives shall be designed for not less than 150 percent of the connected driving capacity. Motor sheaves shall be variable pitch for 15 hp and below and fixed pitch as defined by ARI Guideline D. Variable pitch sheaves shall be selected to drive the fan at a speed which will produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, a replaceable sheave shall be provided when needed to achieve system air balance. Motors for V-belt drives shall be provided with adjustable rails or bases. Removable metal guards shall be provided for all exposed V-belt drives, and speed-test openings shall be provided at the center of all rotating shafts. Fans shall be provided with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Fan and motor assemblies shall be provided with vibration-isolation supports or mountings as indicated. Vibration-isolation units shall be standard products with published loading ratings. Each fan shall be selected to produce the capacity required at the fan static pressure indicated. Sound power level shall be as indicated. The sound power level values shall be obtained according to AMCA 300. Standard AMCA arrangement, rotation, and discharge shall be as indicated.

2.7.1.1 Centrifugal Type Power Roof Ventilators

Fans shall be direct or V-belt driven with backward inclined, non-overloading wheel. Motor compartment housing shall be hinged or removable and weatherproof, constructed of heavy gauge aluminum. Fans shall be provided with birdscreen, disconnect switch, gravity dampers, roof curb, and extended base. Motors enclosure shall be dripproof type. Grease-laden kitchen exhaust fans shall be centrifugal type according to UL 705 and fitted with V-belt drive, round hood, and windband upblast discharge configuration, integral residue trough and collection device, motor and power transmission components located in outside positively air ventilated compartment. Lubricated bearings shall be provided.

2.7.1.2 Ceiling Exhaust Fans

Suspended cabinet-type ceiling exhaust fans shall be centrifugal type, direct-driven. Fans shall have acoustically insulated housing. Integral backdraft damper shall be chatter-proof. The integral face grille shall be of egg-crate design or louver design. Fan motors shall be mounted on vibration isolators. Unit shall be provided with mounting flange for hanging unit from above. Fans shall be U.L. listed.

2.7.2 Air Filters

Air filters shall be listed according to requirements of UL 900, except high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method shall be as listed under the Label Service and shall meet the requirements of UL 586.

2.7.2.1 Replaceable Media Filters

Replaceable media filters shall be the dry-media type, of the size required to suit the application. Filtering media shall be not less than 2 inches thick fibrous glass media pad supported by a structural wire grid or woven wire mesh. Pad shall be enclosed in a holding frame of not less than 16 gauge galvanized steel, and equipped with quick-opening mechanism for changing filter media. The air flow capacity of the filter shall be based on net filter face velocity not exceeding 300 feet per minute, with initial resistance of 0.15 inches water gauge. Average efficiency shall be not less than 30 percent when tested according to ASHRAE 52.1.

2.8 FACTORY PAINTING

Units which are not of galvanized construction according to ASTM A 123 or ASTM A 924 shall be factory painted with a corrosion resisting paint finish. Internal and external ferrous metal surfaces shall be cleaned, phosphatised and coated with a paint finish which has been tested according to ASTM B 117, ASTM D 1654, and ASTM D 3359. Evidence of satisfactory paint performance for a minimum of 125 hours for units to be installed indoors and 500 hours for units to be installed outdoors shall be submitted. Rating of failure at the scribe mark shall be not less than 6, average creepage not greater than 1/8 inch. Rating of the inscribed area shall not be less than 10, no failure. On units constructed of galvanized steel which have been welded, exterior surfaces of welds or welds that have burned through from the interior shall receive a final shop docket of zinc-rich protective paint according to ASTM D 520 Type I.

PART 3 - EXECUTION

3.1 INSTALLATION

Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.

3.1.1 Condensate Drain Lines

Water seals shall be provided in the condensate drain from all units. The depth of each seal shall be 2 inches plus the number of inches, measured in water gauge, of the total static pressure rating of the unit to which the drain is connected. Water seals shall be constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Pipe cap or plug cleanouts shall be provided where indicated. Drains indicated to connect to the sanitary waste system shall be connected by an indirect waste fitting. Air conditioner drain lines shall be insulated as specified in Section 15250 - THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.1.2 Equipment and Installation

Frames and supports shall be provided for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports. Air handling units shall be floor mounted or ceiling hung, as indicated. The method of anchoring and fastening shall be as detailed. Floor-mounted equipment, unless otherwise indicated, shall be set on not less than 6 inch concrete pads or curbs doweled in place. Concrete foundations for

circulating pumps shall be heavy enough to minimize the intensity of the vibrations transmitted to the piping and the surrounding structure, as recommended in writing by the pump manufacturer. In lieu of a concrete pad foundation, a concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. The concrete foundation or concrete pedestal block shall be of a mass not less than three times the weight of the components to be supported. Lines connected to the pump mounted on pedestal blocks shall be provided with flexible connectors. Foundation drawings, bolt-setting information, and foundation bolts shall be furnished prior to concrete foundation construction for all equipment indicated or required to have concrete foundations.

3.1.3 Access Panels

Access panels shall be provided for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced.

3.1.4 Flexible Connectors

Pre-insulated flexible connectors and flexible duct shall be attached to other components in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Hangers, when required to suspend the connectors, shall be of the type recommended by the connector or duct manufacturer and shall be provided at the intervals recommended.

3.1.5 Sleeved and Framed Openings

Space between the sleeved or framed opening and the duct or the duct insulation shall be packed as specified in Section 07270 - FIRESTOPPING for fire rated penetrations. For non-fire rated penetrations, the space shall be packed as specified in Section 07920 - JOINT SEALING.

3.1.6 Metal Ductwork

Installation shall be according to SMACNA-06 unless otherwise indicated. Duct supports for sheet metal ductwork shall be according to SMACNA-06, unless otherwise specified. Friction beam clamps indicated in SMACNA-06 shall not be used. Risers on high velocity ducts shall be anchored in the center of the vertical run to allow ends of riser to move due to thermal expansion. Supports on the risers shall allow free vertical movement of the duct. Supports shall be attached only to structural framing members and concrete slabs. Supports shall not be anchored to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, suitable intermediate metal framing shall be provided. Where C-clamps are used, retainer clips shall be provided.

3.1.7 Acoustical Duct Lining

Lining shall be applied in cut-to-size pieces attached to the interior of the duct with nonflammable fire resistant adhesive conforming to ASTM C 916, Type I, NFPA 90A, UL 723, and ASTM E 84. Top and bottom pieces shall lap the side pieces and shall be secured with welded pins, adhered clips of metal, nylon,

or high impact plastic, and speed washers or welding cup-head pins installed according to SMACNA-06. Welded pins, cup-head pins, or adhered clips shall not distort the duct, burn through, nor mar the finish or the surface of the duct. Pins and washers shall be flush with the surfaces of the duct liner and all breaks and punctures of the duct liner coating shall be sealed with the nonflammable, fire resistant adhesive. Exposed edges of the liner at the duct ends and at other joints where the lining will be subject to erosion shall be coated with a heavy brush coat of the nonflammable, fire resistant adhesive, to prevent delamination of glass fibers. Duct liner may be applied to flat sheet metal prior to forming duct through the sheet metal brake. Lining at the top and bottom surfaces of the duct shall be additionally secured by welded pins or adhered clips as specified for cut-to-size pieces. Other methods indicated in SMACNA-06 to obtain proper installation of duct liners in sheet metal ducts, including adhesives and fasteners, will be acceptable.

3.1.8 Dust Control

To prevent the accumulation of dust, debris and foreign material during construction, temporary dust control protection shall be provided. The distribution system (supply and return) shall be protected with temporary seal-offs at all inlets and outlets at the end of each day's work. Temporary protection shall remain in place until system is ready for startup.

3.1.9 Insulation

Thickness and application of insulation materials for ductwork, piping, and equipment shall be according to Section 15250 - THERMAL INSULATION FOR MECHANICAL SYSTEMS. Outdoor air intake ducts and plenums shall be externally insulated up to the point where the outdoor air mixes with the outside air stream.

3.1.10 Duct Test Holes

Holes with closures or threaded holes with plugs shall be provided in ducts and plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Extensions, complete with cap or plug, shall be provided where the ducts are insulated.

3.1.11 Power Roof Ventilator Mounting

Foamed 1/2 inch thick, closed-cell, flexible elastomer insulation shall cover width of roof curb mounting flange. Where wood nailers are used, holes shall be pre-drilled for fasteners.

3.1.12 Power Transmission Components Adjustment

V-belts and sheaves shall be tested for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Belts on drive side shall be uniformly loaded, not bouncing. Alignment of direct driven couplings shall be to within 50 percent of manufacturer's maximum allowable range of misalignment.

3.2 FIELD PAINTING AND PIPING IDENTIFICATION

Finish painting of items only primed at the factory or surfaces not specifically noted otherwise and identification for piping are specified in Section 09900 - PAINTING, GENERAL.

3.3 CLEANING AND ADJUSTING

Pipes shall be cleaned free of scale and thoroughly flushed of foreign matter. A temporary bypass shall be provided for water coils to prevent flushing water from passing through coils. Strainers and valves shall be thoroughly cleaned. Prior to testing and balancing, air shall be removed from water systems by operating the air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be plugged or capped after the system has been vented. Inside of ducts, plenums, and casing shall be thoroughly cleaned of debris and blown free of small particles of rubbish and dust and then shall be vacuum cleaned before installing outlet faces. Equipment shall be wiped clean, with traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided prior to startup of all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

3.4 TESTING, ADJUSTING, AND BALANCING

Testing, adjusting, and balancing shall be as specified in Section 15990 - TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS. Testing, adjusting, and balancing shall begin only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

3.5 PERFORMANCE TESTS

After testing, adjusting, and balancing has been completed as specified, each system shall be tested as a whole to see that all items perform as integral parts of the system and temperatures and conditions are evenly controlled throughout the building. Corrections and adjustments shall be made as necessary to produce the conditions indicated or specified. Capacity tests and general operating tests shall be conducted by an experienced engineer. Tests shall cover a period of not less than 1/2 days for each system and shall demonstrate that the entire system is functioning according to the specifications. Coincidental chart recordings shall be made at points indicated on the drawings for the duration of the time period and shall record the temperature at space thermostats or space sensors, the humidity at space humidistats or space sensors and the ambient temperature and humidity in a shaded and weather protected area.

3.6 FIELD TRAINING

The Contractor shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 4 hours of normal working time and shall start after the system is functionally complete but prior to the performance tests. The field instruction shall cover all of the items contained in the approved Operating and Maintenance Instructions.

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SECTION 15990

TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S1.4 (1983; S1.4A) Sound Level Meters

ANSI S1.11 (1986; R 1993) Octave-Band and Fractional-Octave-Band Analog and Digital Filters

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 111 (1988) Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1 (1989) National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB-01 (1991) Procedural Standards for Testing Adjusting Balancing of Environmental Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (1993) Installation of Air Conditioning and Ventilating Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA-07 (1993) HVAC Systems - Testing, Adjusting and Balancing

1.2 GENERAL REQUIREMENTS

The Contractor shall select AABC MN-1, NEBB-01, SMACNA-07 or ASHRAE 111 as the standard for providing testing, adjusting and balancing of air and water systems. The selected standard shall be used throughout the project. Testing, adjusting, and balancing shall be accomplished by a firm certified

for testing and balancing by Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB). Prior to testing, adjusting, and balancing, the Contractor shall verify that the systems have been installed and are operating as specified. Approved detail drawings and all other data required for each system and/or component to be tested shall be made available at the jobsite during the entire testing, adjusting and balancing effort. The Contractor shall verify that all balancing devices are properly installed to permit testing, adjusting and balancing and that all duct leakage tests have been completed prior to testing, adjusting and balancing. The Contracting Officer shall be notified in writing of all equipment, components, or balancing devices, that are damaged, incorrectly installed, or missing, as well as any design deficiencies that will prevent proper testing, adjusting, and balancing. Testing, adjusting, and balancing shall not commence until approved by the Contracting Officer. Instrumentation accuracy shall be in accordance with the standard selected in this paragraph.

1.3 INSTRUMENT ACCURACY REQUIREMENTS

All instrumentation shall be checked for accuracy before beginning testing, adjusting and balancing procedures. Instrument accuracy shall be in accordance with the standard selected in paragraph GENERAL REQUIREMENTS. Checks may be carried out against similar equipment maintained specifically for checking purposes or by the manufacturer or a recognized testing facility. All instrumentation used for testing shall be calibrated within 6 months of use. Pitot tubes and U-tube manometers do not require checking. In no case shall the instrumentation accuracy be less than specified by the instrument manufacturer. Any instrument falling out of calibration during the process of balancing and testing shall be recalibrated or removed from the site and replaced by a properly calibrated instrument. No instruments shall be allowed to remain on-site that are not in calibration.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-09 Reports

Testing and Balancing; FIO.

Three copies of a preliminary report, 30 days before balancing commences. The report shall be organized by specific systems and shall clearly identify each item of equipment to be tested, adjusted, and balanced. The appropriate test procedures and measurements to be taken for each item of equipment shall be listed. Instrument calibration records shall be provided on forms shown in AABC MN-1 or SMACNA-07. Manufacturer's specified accuracy shall be shown. The report shall include floor plans showing all measurement locations and types of measurements to be made. All related data necessary for testing, balancing, and adjusting, including fan curves and pump curves, shall be included. A system readiness checklist, similar to that shown in SMACNA-07, shall be included. The report shall contain a listing of the deficiencies of all systems to be tested, adjusted and balanced and the corrective action taken. The report shall contain a schedule for the testing and balancing.

Six copies of the final report on forms shown in AABC MN-1 or SMACNA-07, 30 days after completion of the test and balance operation. Data shall be in a hard bound cover identifying the project name, location, date of submittal, name of Contractor, and a general title indicating the specific area and type of work, and shall be signed by a registered professional engineer, employed by the test and balance firm, who has a minimum of 2 years experience in testing, adjusting and balancing work. The final report shall include a summary describing test methods, test results, and major corrective actions taken. The report shall include as-tested floor plans showing all measurement locations and types of measurements made. The air handling unit data shall include a static pressure profile diagram, and pitot tube traverses where possible. Air distribution data shall include coded drawings which show the exact location of each air outlet.

All instruments that are recalibrated and brought back onto the jobsite after being found to be out of calibration shall have recalibration records submitted on forms shown in AABC MN-1 or SMACNA-07.

SD-13 Certificates

Qualification; FIO.

Qualification data, 90 days prior to testing and balancing operations. The test and balance firm shall be certified by the Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB). The lead balancing technician shall be qualified by AABC or NEBB and his qualification data shall include past experience on at least five similar projects.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TESTING AND BALANCING

3.1.1 General

The facility shall be essentially complete with final ceiling, walls, windows, doors and partitions in place. Doors and windows surrounding each area to be balanced shall be closed during testing and balancing operations. Air systems shall be complete and operable with balancing dampers, ducting, diffusers, returns, flow control boxes and control components in place. Exhaust fans and fume hoods shall be operational. Hydronic systems shall be complete and operable with balancing valves, flow meters, coils, pumps, piping and control components in place. All measurements and adjustments shall be made using procedures described in standard selected in paragraph GENERAL REQUIREMENTS. Air motion and distribution from air terminals shall be as shown. Smoke tests may be used to demonstrate proper air distribution from air terminals. All data including deficiencies encountered and corrective action taken shall be recorded. If a system cannot be adjusted to meet the design requirements, the Contractor shall promptly notify the Contracting Officer in writing.

3.1.2 Air Systems

Clean filters shall be installed at the beginning of the testing, adjusting, and balancing effort. Each system shall be adjusted until all flow quantities

are within plus ten percent and minus zero percent. Dampers shall be checked for tight shutoff. Air leakage around dampers shall be verified. Fans shall be checked for correct direction of rotation and proper speed shall be verified. Fire and smoke dampers shall be tested at system design air flow to ensure proper closure in accordance with NFPA 90A and manufacturer's instructions prior to building occupancy.

3.1.2.1 General Balancing Methods

In addition to the requirements for specific systems, flows in supply, exhaust and return air systems shall be balanced using the methods in standard selected in paragraph GENERAL REQUIREMENTS. Throttling losses shall be limited. Air flow adjustments shall be made by first adjusting the fan speed to meet the design flow conditions. Fan speed adjustment may not be required for fan motors which are less than one horsepower, or if throttling results in no greater than an additional 1/3 horsepower draw above that required if the fan speed were adjusted. Flows and pressures shall be checked in all main risers and supply ducts at all supply, exhaust and return fan discharges. All flows shall be recorded before and after each adjustment.

3.1.2.2 Specific Systems

All special or additional procedures for testing and balancing shall be in accordance with the applicable requirements of the standard selected in paragraph GENERAL REQUIREMENTS. If a system has diversity, only the required quantity of wide open terminals shall be used to meet the design air flow.

3.1.3 Marking of Setting

Following final acceptance of certified reports by the Contracting Officer, the setting of all HVAC adjustment devices including valves, splitters, and dampers shall be permanently marked by the testing and balancing engineer so that adjustment can be restored if disturbed at any time.

3.1.4 Marking of Test Ports

The testing and balancing engineer shall permanently and legibly mark and identify the location points of the duct test ports. If the ductwork has exterior insulation, these markings shall be made on the exterior side of the ductwork insulation. All penetrations through ductwork and ductwork insulation shall be properly sealed to prevent air leakage or loss of vapor barrier.

3.1.5 Sound Level Testing

After the systems are properly tested, adjusted and balanced, sound levels shall be checked in accordance with the applicable provisions of AABC MN-1. Octave-band analysis and noise-criteria curve data shall be recorded on forms shown in AABC MN-1. All occupied areas including offices, corridors, auditorium and meeting rooms, and hospital rooms shall be verified to be within the sound levels shown or as specified. Any areas not meeting the requirements of AABC MN-1 or the specifications or drawings shall be clearly indicated on the form and an explanation of all discrepancies shall be provided in test report.

3.2 CONTROL SYSTEMS

Testing, adjusting, and balancing of the systems shall be coordinated with the control system installation. All control components shall be verified to be properly installed and operating as specified before proceeding with testing, adjusting, and balancing. Verification shall be in accordance with AABC MN-1.

3.3 COMPLETION TIME FOR TESTING

If completion time for the building precludes performing these tests at or near design temperature and conditions, the tests will be considered as preliminary for acceptance of the building for beneficial use. The Contractor will be responsible for final testing and fine balancing of the heating and cooling system during the next heating and cooling season at a time when outside conditions are at or near design conditions. If weather conditions during the heating and cooling season do not approach design conditions, the final testing will be completed prior to 15 February for heating and 30 August for cooling following completion of the building.

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SECTION 16262

AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- | | |
|---------------|--|
| IEEE C37.13 | (1990) Low-Voltage AC Power Circuit Breakers Used in Enclosures |
| IEEE C37.90.1 | (1989; R 1991) IEEE Standard Surge Withstanding Capability (SWC) Tests for Protective Relays and Relay Systems |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- | | |
|------------|---|
| NEMA ICS 1 | (1993) Industrial Controls and Systems |
| NEMA ICS 2 | (1993) Industrial Control Devices, Controllers and Assemblies |
| NEMA ICS 4 | (1993) Terminal Blocks for Industrial Use |
| NEMA ICS 6 | (1993) Enclosures for Industrial Control and Systems |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- | | |
|----------|--|
| NFPA 70 | (1999) National Electrical Code |
| NFPA 110 | (1993) Emergency and Standby Power Systems |

UNDERWRITERS LABORATORIES (UL)

- | | |
|---------|--|
| UL 1008 | (1989; Rev thru Dec 1993) Automatic Transfer Switches |
| UL 1066 | (1993; Rev May 1993) Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures |

1.2 GENERAL REQUIREMENTS**1.2.1 Standard Product**

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid

opening. The experience use shall include applications of equipment and materials under similar circumstances and of the same design and rating as the switches specified. Equipment items shall be capable of being serviced by an organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

1.2.2 Nameplates

Nameplates shall be made from a corrosion-resistant metal with not less than 6.4 mm (1/4 inch) tall raised or engraved characters. The nameplate shall be mounted to the front of the enclosure and shall comply with nameplate requirements covered by NEMA ICS 2.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-04 Drawings

Switches, FIO.

A one-line diagram of each ATS assembly and elementary, or schematic, and wiring diagram of the unit. An interface equipment connection diagram showing all conduit and wiring between the ATS and all other related equipment. Device and nameplate numbers and item numbers shown on the list of equipment and material shall appear on drawings wherever the item of equipment or material appears. The one-line diagram shall show interlocking provisions and cautionary notes, if any. Operating instructions shall be shown on the one-line diagram or separately, at the discretion of the Contractor. The manufacturer's approved operating instructions for the ATS shall be laminated in plastic and permanently secured to the cabinet where the operator can see them. The one-line and elementary or schematic diagram shall be laminated in plastic and permanently secured to the inside of the front enclosure door.

SD-07 Schedules

Material, Equipment, and Fixture Lists, FIO.

A complete list of equipment and material proposed, containing an adequate description of each separate item of equipment or material recommended.

SD-09 Reports

Tests, FIO.

Certified factory and field test reports, within 14 days following completion of the tests. Reports shall be certified and dated and shall demonstrate that the tests were successfully completed prior to shipment of the equipment.

SD-13 Certificates

Equipment and Materials, FIO.

Evidence of a UL listing, or conformance with applicable NEMA standards. Certificates of compliance will be accepted as proof of compliance when equipment or materials are required to conform to UL standards or to be manufactured and/or tested by NEMA standards. Such certificates are not required if manufacturer's published data, submitted and approved, reflect a UL listing or conformance with applicable publications of NEMA. Proof of the listing by UL and conformance with the applicable publications, of NEMA do not relieve the Contractor of compliance with other provisions of these specifications.

Switching Equipment, FIO.

Proof of listing by UL sufficient to demonstrate that the ATS conform to the specified requirements except as otherwise specified. Modification to a former UL listed ATS model shall require written UL approval of the modification. A copy of the written UL approval for modifications shall be included with the certified test reports specified. In lieu of the proof of listing by UL, the Contractor may have identical tests required by UL 1008 and by NEMA ICS 2 performed by a nationally recognized independent testing laboratory. UL and NEMA or other certified test reports shall be included to demonstrate the sequence of laboratory testing and that the overload, endurance, and temperature rise tests were conducted in that specific sequence of tests. The certified test reports shall show the date, times and duration of the overload, endurance, and temperature tests, and that the unit under test was not de-energized during the test sequence. Other tests shall be conducted in the sequence shown in paragraph TESTING unless otherwise justified and approved. Certified test reports shall also be included to demonstrate compliance with the withstand rating specified or shown, and shall be accompanied by oscillographic traces of phase current and line-to-neutral voltages. These traces shall demonstrate that the main and neutral contacts did not separate and were not damaged during the withstand test. The certified test reports from the testing laboratory shall be signed by the person performing the test and an authorized representative of the testing laboratory. The report shall verify that the ATS was tested in accordance with procedures described in UL 1008, or as otherwise specified and are of the same model number and ampacity as the switches specified. The test report shall verify that the tested unit passed all tests without modification or repair during a test period of not more than 90 days. The 90-day period does not include the time required to perform additional testing necessary to demonstrate compliance with the withstand rating provisions of these specifications.

SD-19 Operation and Maintenance Manuals

Switching Equipment, FIO.

Six complete copies of operating manual outlining the step-by-step procedures required for system startup, operation and shutdown. The manuals shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and basic operating features. The manufacturer's spare parts data shall be included in the instruction manuals

and correlated with the respective item of equipment included as a component part of the switch assembly. Spare parts data shall include the recommended spare parts published by the manufacturer of the equipment. The source of supply and the current cost of recommended spare parts shall be indicated. Six complete copies of maintenance manual listing routine maintenance, possible breakdowns, repairs and troubleshooting guide. The manuals shall include simplified wiring and control diagrams for the system as installed.

1.4 SERVICE CONDITIONS

ATS shall be suitable for satisfactory and prolonged performance under the following service conditions:

- a. Altitude: 1112 feet above mean sea level.
- b. Relative Humidity: 51 percent maximum, continuous.
- c. Temperature: 30 degrees F to 115 degrees F.
- d. Seismic Zone: 1 .

PART 2 - PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCH (ATS)

ATS shall be the electrically-operated type that is mechanically held in both operating positions. ATS shall be suitable for use in standby systems described in NFPA 70. ATS shall be UL listed unless the Contractor retains a nationally recognized independent testing laboratory to conduct tests as specified in paragraph SUBMITTALS, and test reports are approved as being equivalent of test results and certified test reports as those determined and reported by UL. ATS shall be the electrically-operated contactor type which shall be manufactured and tested in accordance with applicable requirements of IEEE C37.90.1, NEMA ICS 1, NEMA ICS 2, and UL 1008. ATS shall also conform to NFPA 110 except that the ATS shall not be equipped with either overload or fault current protective devices. ATS shall be designed and manufactured to prevent stops in an intermediate or neutral position during transfer by the use of electrical actuators and stored-energy mechanisms. ATS designed and manufactured to effect transfers by a walking-beam or a similar device to engage handles of circuit breakers to accomplish transfer between power sources are unacceptable. Each pole of the doublethrow ATS shall have separate arcing contacts of a nonwelding type with switch contacts installed to permit viewing of the contacts without disassembly of the ATS or removal of the entire contact enclosure, or component parts of the ATS. ATS shall be rated for continuous duty at the continuous current rating specified. All rating data shall be shown on detail drawings, and shall equal or exceed those specified. Switches shall be adequately rated for the application indicated, and shall have the following characteristics:

- a. Voltage: 120/208 volts ac.
- b. Number of Phases: Three.
- c. Number of Wires: Four.

- d. Frequency: 60 Hz.
- e. Number of Switched Poles: Four.
- f. Type of Load: Standby Power.
- g. Continuous Phase or Main Current Rating: Equal to or exceed the rating shown but, in no case, less than 125 percent of the full load rating of the alternate power source amperes.
- h. ATS Withstand Rating (Fault Current Availability Rating): Rated to withstand an available fault or short-circuit current of 42,000 amperes, RMS symmetrical, at a power factor between 0.0 and approximately 0.20, for a duration of 3 cycles at a maximum voltage of 120/208 ac.
- i. Overload Rating: 125% of continuous current rating, RMS symmetrical.
- j. Nonwelding of Contacts: Rated for nonwelding of contacts when used with the feeder overcurrent devices indicated on the drawings and with the available fault current specified herein.
- k. Main and Neutral Contacts: Contacts shall have a silver composition and shall be protected by approved arcing contacts. Neutral contacts shall have the same continuous current rating as the main or phase contacts.

2.1.1 Override Time Delay

Time delay to override monitored source deviation shall be adjustable from 0.5 to 6 seconds and factory set at 1 seconds. The device shall detect and respond to a sustained voltage drop of 30 percent of nominal voltage between any two of the normal supply conductors and initiate transfer action to the alternate source and start the engine-driven generator set after the set time period. The pickup voltage shall be adjustable between 10 and 100 percent of nominal and factory set 90 percent. The dropout voltage shall be adjustable from 10 to 100 percent of the pickup value, and factory set at 80 percent of nominal voltage.

2.1.2 Transfer Time Delay

Time delay before transfer to the alternate power source shall be adjustable from 2 sec to 2 minutes and factory set at 5 seconds. The device shall monitor the frequency and voltage of the alternate power source and transfer when frequency and voltage is stabilized at or above the following values. The pickup voltage shall be adjustable from 70 to 100 percent of nominal, and factory set at 90 percent of normal. The pickup frequency shall be adjustable from 90 to 100 percent of nominal and factory set at 95 percent of normal.

2.1.3 Return Time Delay

Time delay before return transfer to the normal power source shall be adjustable from 0 to 30 minutes and factory set at 30 minutes. The time delay shall be automatically defeated upon loss or sustained undervoltage of the alternate power source, provided that the normal supply has been restored.

2.1.4 Auxiliary Contacts

Two normally open and two normally closed auxiliary switches shall operate when the transfer switch is connected to the normal power source, and two normally open and two normally closed switches shall operate when the transfer switch is connected to the alternate power source.

2.1.5 Supplemental Features

The ATS shall also be furnished with the following:

- a. Alternate source monitor.
- b. Test switch.
- c. Close differential protection.
- d. Time delay by-pass switch.
- e. Manual return-to-normal switch.
- f. Deleted.

2.1.6 Operator

A manual operator, conforming to the applicable provisions of UL 1008, shall be provided to permit manual operation of the ATS without opening the ATS enclosure, and incorporate features to prevent operation by other than authorized and qualified personnel. The ATS shall be designed for use of the manual operator under no load conditions in the usual instances, but with the capability of operation under load conditions when necessary.

2.1.7 Override Switch

The override switch shall by-pass automatic transfer controls so the transfer switch will transfer and remain connected to the alternate power source, regardless of the conditions of the normal power source. If the alternate source fails and the normal source is available, the transfer switch shall automatically retransfer to the normal source.

2.1.8 Green Indicating Lights

A green indicating light shall supervise the normal power source and shall have a nameplate engraved NORMAL.

2.1.9 Red Indicating Lights

A red indicating light shall supervise the alternate power source and shall have a nameplate engraved ALTERNATE.

2.2 ENCLOSURE

ATS and accessories shall be in a free-standing, floor-mounted and unventilated NEMA ICS 6, Type I, smooth sheet metal enclosure constructed in

accordance with UL 1008. Gauge of the metal shall be not less than No. 14. Doors shall have suitable hinges, locking handle latch, and gasketed jambs. Enclosure shall be equipped with at least two approved size and type of grounding lugs for the purpose of grounding the enclosure using No. 4 AWG copper conductors to the facility ground system. Factory wiring within the enclosure and the Contractor's field wiring terminating within the enclosure shall comply with NFPA 70. If wiring is not color coded, wires shall be permanently tagged near the terminal at each end with the wire number shown on approved detail drawings. Terminal blocks shall conform to NEMA ICS 4. Terminal facilities shall be suitably arranged for entrance of external conductors from the top and bottom, as shown. Main switch terminals, including the neutral terminal, shall be of the pressure type and suitable for the termination of the external copper conductors shown.

2.2.1 Construction

Enclosure shall be constructed for convenient removal and replacement of contacts, coils, springs and control devices from the front without the disconnection of external power conductors or the removal or disassembly of major components.

2.2.2 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as specified in Section 09900 PAINTING, GENERAL.

2.3 TESTING

2.3.1 Laboratory Testing

Testing shall be completed on the ATS to be supplied under these specifications, or shall have been completed on a previous, randomly selected standard production ATS unit having the same model number and capacity as the ATS specified. Overload, endurance and temperature tests shall be conducted in that sequence and within the shortest practicable period of time on the same ATS without de-energization of that ATS under test. The test sequence for the ATS listed below shall be followed. No deviation will be granted that is less stringent. Approval will not be granted to deviate from the overload, endurance and temperature test sequence.

- a. General
- b. Normal Operation
- c. Overvoltage
- d. Undervoltage
- e. Overload
- f. Endurance
- g. Temperature rise

- h. Dielectric Voltage - Withstand
- i. Contact Opening
- j. Dielectric Voltage - Withstand (Repeated)
- k. Withstand
- l. Instrumentation and Calibration of High Capacity Circuits
- m. Closings
- n. Dielectric Voltage - Withstand (Repeated)
- o. Strength of Insulating Base and Support

2.3.2 Factory Testing

In addition to other factory tests, each completely assembled ATS unit shall be subjected to dielectric and operational tests.

2.3.2.1 Withstand Test in Excess of UL 1008 Requirements

The ATS shall be tested and rated to withstand an available fault or short-circuit current of 42,000 amperes, RMS symmetrical, at a power factor between 0.0 and approximately 0.20 for a duration of 3 cycles at a maximum voltage of 120/208 ac.

2.3.2.2 Dielectric Tests

Tests shall be performed in accordance with NEMA ICS 1. Wiring of each control panel shall be subjected to voltage surge tests as stipulated in IEEE C37.90.1. Impulse withstand rating tests shall be performed accordance with the requirements of NEMA ICS 1.

2.3.2.3 Operational Tests

Tests shall be performed and shall demonstrate that the operational sequence of each ATS unit conforms to the requirements of the specifications with regard to operating transfer time, voltage, frequency, and timing intervals.

PART 3 - EXECUTION

3.1 INSTALLATION

The ATS shall be installed as indicated and in accordance with approved manufacturer's instructions.

3.2 OPERATIONAL TESTING

Following completion of the installation of the ATS, the Contractor shall perform operational tests in accordance with the written instructions of the manufacturer after having made proper adjustments and settings to demonstrate that the ATS functions satisfactorily and as specified. The Contractor shall advise the Contracting Officer not less than 5 work days prior to the

scheduled date or dates for operational testing, and shall provide certified field test reports to the Contracting Officer within 2 calendar weeks following successful completion of the operational tests. The test reports shall describe all adjustments and settings made and all operational tests performed.

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SECTION 16415

ELECTRICAL WORK, INTERIOR

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1	(1995) Code for Electricity Metering
ANSI C12.4	(1984; R 1990) Mechanical Demand Registers
ANSI C12.10	(1987) Electromechanical Watthour Meters
ANSI C12.11	(1987; R 1993) Instrument Transformer for Revenue Metering, 10 kV BIL Through 350 kV BIL (0.6 kV NSV Through 69 kV NSV)
ANSI C37.16	(1988; C37.16a) Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations
ANSI C39.1	(1981; R 1992) Requirements for Electrical Analog Indicating Instruments
ANSI C57.12.10	(1988) Safety Requirements for Transformers 230 kV and Below 833/958 Through 8333/10417 kVA, Single-Phase, and 750/862 Through 60 000/80 000/100 000 kVA, Three-Phase Without Load Tap Changing; and 3750/4687 Through 60 000/80 000/100 000 kVA With Load Tap Changing
ANSI C57.12.13	(1982) Conformance Requirements for Liquid-Filled Transformers Used in Unit Installations, Including Unit Substations
ANSI C57.12.27	(1982) Conformance Requirements for Liquid-Filled Distribution Transformers Used in Pad-Mounted Installations, Including Unit Substations
ANSI C57.12.50	(1981; R 1989) Ventilated Dry-type Distribution Transformers 1 to 500 kVA, Single-Phase; and 15 to 500 kVA, Three-Phase with High-Voltage 601 to 34 500 Volts, Low-Voltage 120 to 600 Volts
ANSI C57.12.51	(1981; R 1989) Ventilated Dry-Type Power Transformers, 501 kVA and Larger, Three-Phase, with

High-Voltage 601 to 34 500 Volts, Low-Voltage
208Y/120 to 4160 Volts

ANSI C57.12.52 (1981; R 1989) Sealed Dry-Type Power Transformers,
501 kVA and Larger, Three-Phase, with High-Voltage
601 to 34 500 Volts, Low-Voltage 208Y/120 to 4160
Volts

ANSI C57.12.70 (1978; R 1993) Terminal Markings and Connections for
Distribution and Power Transformers

ANSI C80.5 (1990) Rigid Aluminum Conduit

ANSI C82.1 (1985; C82.1a; C82.1b; C82.1c; R 1992)
Specifications for Fluorescent Lamp Ballasts

ANSI C82.4 (1992) Ballasts for High-Intensity-Discharge and
Low-Pressure Sodium Lamps (Multiple-Supply Type)

ANSI C135.30 (1988) Zinc-Coated Ferrous Ground Rods for Overhead
or Underground Line Construction

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1 (1990) Hard-Drawn Copper Wire

ASTM B 8 (1993) Concentric-Lay-Stranded Copper Conductors,
Hard, Medium-Hard, or Soft

ASTM D 709 (1992) Laminated Thermosetting Materials

ASTM D 4059 (1991) Analysis of Polychlorinated Biphenyls in
Insulating Liquids by Gas Chromatography

CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 18 Industrial, Scientific and Medical Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (1997) National Electrical Safety Code

IEEE C37.13 (1990) Low-Voltage AC Power Circuit Breakers Used in
Enclosures

IEEE C37.20.1 (1993) Metal-Enclosed Low-Voltage Power
Circuit-Breaker Switchgear

IEEE C57.12.00 (1993) IEEE Standard General Requirements for
Liquid-Immersed Distribution, Power, and Regulating
Transformers

IEEE C57.12.80 (1978; R 1992) Terminology for Power and
Distribution Transformers

IEEE C57.12.90	(1993) Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers
IEEE C57.13	(1993) Instrument Transformers
IEEE C57.98	(1993) Guide for Transformer Impulse Tests
IEEE C57.100	(1986; R 1992) Test Procedure for Thermal Evaluation of Oil-Immersed Distribution Transformers
IEEE C62.41	(1991) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)
IEEE Std 242	(1986; R 1991) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE Std 399	(1990) Recommended Practice for Power Systems Analysis

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA BU 1	(1994) Busways
NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA ICS 1	(1993) Industrial Controls and Systems
NEMA ICS 2	(1993) Industrial Control and Systems, Controllers, Contactors Overload Relays Rated not More Than 2,000 Volts AC or 750 DC
NEMA ICS 3	(1993) Industrial Systems
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA LE 4	(1987) Recessed Luminaires, Ceiling Compatibility
NEMA MG 1	(1993; Rev 1) Motors and Generators
NEMA MG 10	(1994) Energy Management Guide for Selection and Use of Polyphase Motors

NEMA OS 1	(1989) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA OS 2	(1986; Errata Aug 1986; R 1991) Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
NEMA PB 1	(1990) Panelboards
NEMA PB 2	(1989) Deadfront Distribution Switchboards
NEMA PE 5	(1985; R 1991) Utility Type Battery Chargers
NEMA RN 1	(1989) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA SG 3	(1990) Low-Voltage Power Circuit Breakers
NEMA ST 20	(1992) Dry-Type Transformers for General Applications
NEMA TC 2	(1990) Electrical Polyvinyl Chloride (PVC) Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA TC 13	(1993) Electrical Nonmetallic Tubing (ENT)
NEMA VE 1	(1991) Metallic Cable Tray Systems
NEMA WD 1	(1983; R 1989) General Requirements for Wiring Devices
NEMA WD 6	(1988) Wiring Devices - Dimensional Requirements
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 70	(1999) National Electrical Code
NFPA 101	(1994) Safety to Life from Fire in Buildings and Structures
UNDERWRITERS LABORATORIES (UL)	
UL-03	(1996) Electrical Construction Materials Directory
UL 1	(1993; Rev thru Jan 1995) Flexible Metal Conduit
UL 4	(1986; Rev thru Nov 1990) Armored Cable
UL 5	(1995) Surface Metal Raceways and Fittings
UL 6	(1993; Rev March 96) Rigid Metal Conduit
UL 20	(1995) General-Use Snap Switches
UL 44	(1991; Rev thru Jun 1996) Rubber-Insulated Wires and Cables

UL 50	(1995) Enclosures for Electrical Equipment
UL 67	(1993; Rev thru Dec 1993) Panelboards
UL 83	(1991; Rev thru Jun 1996) Thermoplastic-Insulated Wires and Cables
UL 98	(1994; R Oct 1995) Enclosed and Dead-Front Switches
UL 198B	(1995) Class H Fuses
UL 198C	(1986; Rev thru Jun 1993) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198D	(1995) Class K Fuses
UL 198E	(1988; Rev Jul 1988) Class R Fuses
UL 198G	(1988; Rev May 1988) Fuses for Supplementary Overcurrent Protection
UL 198H	(1988; Rev thru Nov 1993) Class T Fuses
UL 198L	(1995; Rev May 1995) D-C Fuses for Industrial Use
UL 360	(1986; Rev thru Dec 1995) Liquid-Tight Flexible Steel Conduit
UL 467	(1993; Rev thru Aug 1996) Grounding and Bonding Equipment
UL 486A	(1991; Rev Oct 1991) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1991; Rev thru Oct 1996) Wire Connectors for Use with Aluminum Conductors
UL 486C	(1991; Rev thru Oct 1996) Splicing Wire Connectors
UL 486E	(1994; Rev Aug 95) Equipment Wiring Terminal for Use with Aluminum and/or Copper Conductors
UL 489	(1996) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL 498	(1991; Rev thru Oct 1995) Attachment Plugs and Receptacles
UL 506	(1994; Rev Jul 1994) Specialty Transformers
UL 508	(1993) Industrial Control Equipment
UL 510	(1994) Insulating Tape
UL 512	(1993; R Dec 1995) Fuseholders

UL 514A	(1991; Rev Jun 1996) Metallic Outlet Boxes
UL 514B	(1989; Rev thru Apr 1995) Fittings for Conduit and Outlet Boxes
UL 514C	(1988; Rev thru Jul 1996) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 542	(1994) Lampholders, Starters, and Starter Holders for Fluorescent Lamps
UL 651	(1995) Schedule 40 and 80 Rigid PVC Conduit
UL 651A	(1995) Type EB and A Rigid PVC Conduit and HDPE Conduit
UL 674	(1994; Rev thru Jul 1996) Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 698	(1995; Rev thru Jul 1996) Industrial Control Equipment for Use in Hazardous (Classified) Locations
UL 719	(1996) Nonmetallic-Sheathed Cables
UL 797	(1993; Rev May 1995) Electrical Metallic Tubing
UL 817	(1994; Rev thru May 1996) Cord Sets and Power-Supply Cords
UL 844	(1995; Rev thru Aug 1996) Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
UL 845	(1995; Rev Feb 1996) Motor Control Centers
UL 854	(1996) Service-Entrance Cables
UL 857	(1994; Rev Oct 1994) Busways and Associated Fittings
UL 869A	(1993; Rev Apr 1994) Reference Standard for Service Equipment
UL 877	(1993; Rev Jul 1995) Circuit Breakers and Circuit-Breaker Enclosures for Use in Hazardous (Classified) Locations
UL 886	(1994; Rev thru Jul 1995) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 891	(1994; Rev thru Jan 1995) Dead-Front Switchboards
UL 924	(1995; Rev May 1995) Emergency Lighting and Power Equipment
UL 935	(1995; Rev Jun 1995) Fluorescent-Lamp Ballasts

UL 943	(1993; Rev thru Sep 1996) Ground-Fault Circuit Interrupters
UL 1004	(1994; Rev thru May 1996) Electric Motors
UL 1010	(1995; Rev thru Jul 1996) Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations
UL 1022	(1994) Line Isolation Monitors
UL 1029	(1994; Rev Sep 1995) High-Intensity-Discharge Lamp Ballasts
UL 1047	(1995) Isolated Power Systems Equipment
UL 1236	(1994; Rev thru Apr 1996) Battery Chargers for Charging Engine-Starter Batteries
UL 1242	(1983; Rev thru Jul 1993) Intermediate Metal Conduit
UL 1449	(1985; Errata Apr 1986) Transient Voltage Surge Suppressors
UL 1564	(1993; Rev Apr 1994) Industrial Battery Chargers
UL 1569	(1995) Metal-Clad Cables
UL 1570	(1995) Fluorescent Lighting Fixtures
UL 1571	(1995; Rev thru Mar 95) Incandescent Lighting Fixtures
UL 1572	(1995; Rev thru Sep 96) High Intensity Discharge Lighting Fixtures
UL 1660	(1994) Liquid-Tight Flexible Nonmetallic Conduit

1.2 GENERAL

1.2.1 Rules

The installation shall conform to the requirements of NFPA 70 and NFPA 101, unless more stringent requirements are indicated herein or shown.

1.2.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment shall be properly located and readily accessible. Lighting fixtures, outlets, and other equipment and materials shall be located to avoid interference with mechanical or structural features; otherwise, lighting fixtures shall be symmetrically located according to the room arrangement when uniform illumination is required, or asymmetrically located to suit conditions

fixed by design and shown. Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. The Contractor shall coordinate electrical work with the HVAC and electrical drawings and specifications and provide power related wiring.

1.2.3 Special Environments

1.2.3.1 Weatherproof Locations

Wiring, Fixtures, and equipment in designated locations shall conform to NFPA 70 requirements for installation in damp or wet locations.

1.2.3.2 Hazardous Locations

Wiring and equipment in locations indicated shall be of the classes, groups, divisions, and suitable for the operating temperature; as indicated.

1.2.3.3 Ducts, Plenums and Other Air-Handling Spaces

Wiring and equipment in ducts, plenums and other air-handling spaces shall be installed using materials and methods in conformance with NFPA 70 unless more stringent requirements are indicated in this specification or on the contract drawings.

1.2.4 Standard Products

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.2.5 NAMEPLATES

1.2.5.1 Identification Nameplates

Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function and specific unit number as indicated. Designation of motors shall coincide with their designation in the motor control center or panel. Unless otherwise specified, identification nameplates shall be made of laminated plastic in accordance with ASTM D 709 with black outer layers and a white core. Edges shall be chamfered. Plates shall be fastened with black-finished round-head drive screws, except motors, or approved nonadhesive metal fasteners. When the nameplate is to be installed on an irregular-shaped object, the Contractor shall devise an approved support suitable for the application and ensure the proper installation of the supports and nameplates. In all instances, the nameplate shall be installed in a conspicuous location. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The front of each panelboard, motor control center, switchgear, and switchboard shall have a nameplate to indicate the phase letter, corresponding color and arrangement of the phase conductors.

The following equipment, as a minimum, shall be provided with identification nameplates:

Minimum 1/4 inch
High Letters

Panelboards
Starters
Safety Switches
Motor Control Centers
Transformers
Equipment Enclosures
Switchgear
Switchboards
Motors

Minimum 1/8 inch
High Letters

Control Power Transformers
Control Devices
Instrument Transformers

Each panel, section, or unit in motor control centers, switchgear or similar assemblies shall be provided with a nameplate in addition to nameplates listed above, which shall be provided for individual compartments in the respective assembly, including nameplates which identify "future," "spare," and "dedicated" or "equipped spaces."

1.2.5.2 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with Nameplate C information in accordance with IEEE C57.12.00. Nameplates shall indicate percent impedance, voltage, kVA, frequency, number of phases, cooling class, insulation class, temperature rise, the number of gallons and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl. For liquid filled transformers, the Contractor shall furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified, with less than 2 ppm PCB content in accordance with paragraph LIQUID DIELECTRICS. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 2ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

1.2.6 As-Built Drawings

Following the project completion or turnover, within 30 days the Contractor shall furnish two sets of as-built drawings to the Contracting Officer.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-01 Data

Fault Current and Protective Device Coordination Study; FIO.

The study shall be submitted along with protective device equipment submittals. No time extensions or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed shall be based on recommendations of this study. The Government shall not be held responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study.

Manufacturer's Catalog; FIO.

Data composed of catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material, Equipment, and Fixture Lists; FIO.

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each item.

Installation Procedures; FIO.

Installation procedures for rotating equipment, transformers, switchgear, battery systems, voltage regulators, and grounding resistors. Procedures shall include diagrams, instructions, and precautions required to install, adjust, calibrate, and test devices and equipment.

SD-04 Drawings

Interior Electrical Equipment; FIO.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams, and other information necessary to define the installation. Detail drawings shall show the rating of items and systems and how the components of an item and system are assembled, function together, and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall show physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. Optional items shall be clearly identified as included or excluded. Detail drawings shall as a minimum include:

- a. Transformers.
- b. Switchgear.
- c. Battery system including calculations for the battery and charger.
- d. Voltage regulators.

- e. Grounding resistors.
- f. Motors and rotating machinery.
- g. Motor control centers.
- h. Busway systems.
- i. Single line electrical diagrams including primary, metering, sensing and relaying, control wiring, and control logic.
- j. Sway bracing for suspended luminaires.

Structural drawings showing the structural or physical features of major equipment items, components, assemblies, and structures, including foundations or other types of supports for equipment and conductors. These drawings shall include accurately scaled or dimensioned outline and arrangement or layout drawings to show the physical size of equipment and components and the relative arrangement and physical connection of related components. Weights of equipment, components and assemblies shall be provided when required to verify the adequacy of design and proposed construction of foundations or other types of supports. Dynamic forces shall be stated for switching devices when such forces must be considered in the design of support structures. The appropriate detail drawings shall show the provisions for leveling, anchoring, and connecting all items during installation, and shall include any recommendations made by the manufacturer.

Electrical drawings including single-line and three-line diagrams, and schematics or elementary diagrams of each electrical system; internal wiring and field connection diagrams of each electrical device when published by the manufacturer; wiring diagrams of cabinets, panels, units, or separate mountings; interconnection diagrams that show the wiring between separate components of assemblies; field connection diagrams that show the termination of wiring routed between separate items of equipment; internal wiring diagrams of equipment showing wiring as actually provided for this project. Field wiring connections shall be clearly identified.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures, including changes in related portions of the project and the reasons why, shall be submitted with the detail drawings. Approved departures shall be made at no additional cost to the Government.

As-Built Drawings; FIO.

The as-built drawings shall be a record of the construction as installed. The drawings shall include all the information shown on the contract drawings, deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be kept at the job site and updated daily. The as-built drawings shall be a full-sized set of prints marked to reflect all deviations, changes, and modifications. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the

Contractor shall submit three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within ten calendar days from the time the drawings are returned to the Contractor.

SD-08 Statements

On-Site Test; GA.

A detailed description of the Contractor's proposed procedures for on-site tests.

SD-09 Reports

Factory Test Reports; GA.

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

- a. A list of equipment used, with calibration certifications.
- b. A copy of measurements taken.
- c. The dates of testing.
- d. The equipment and values to be verified.
- e. The conditions specified for the test.
- f. The test results, signed and dated.
- g. A description of adjustments made.

Field Test Plan; GA.

A detailed description of the Contractor's proposed procedures for on-site test submitted 45 days prior to testing the installed system. No field test will be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Field Test Reports; GA.

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

- a. A list of equipment used, with calibration certifications.
- b. A copy of measurements taken.

- c. The dates of testing.
- d. The equipment and values to be verified.
- e. The conditions specified for the test.
- f. The test results, signed and dated.
- g. A description of adjustments made.
- h. Final position of controls and device settings.

SD-13 Certificates

Materials and Equipment; GA.

The label or listing of the Underwriters Laboratories, Inc., will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements will be accepted. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Contracting Officer. Items which are required to be listed and labeled in accordance with Underwriters Laboratories must be affixed with a UL label that states that it is UL listed. No exceptions or waivers will be granted to this requirement. Materials and equipment will be approved based on the manufacturer's published data.

For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable.

1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with NFPA 70, recommendations of the manufacturer, and as shown.

PART 2 - PRODUCTS

Products shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.1 CABLES AND WIRES

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown

are based on copper, unless indicated otherwise. All conductors shall be copper.

2.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to meet manufacturer's requirements.

2.1.2 Aluminum Conductors. Aluminum conductors shall not be used.

2.1.3 Insulation

Unless indicated otherwise, or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN, THHN, or THW conforming to UL 83 or RHW conforming to UL 44, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW, THW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.1.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.1.5 Service Entrance Cables

Service entrance (SE) and underground service entrance (USE) cables, UL 854.

2.1.6 Cord Sets and Power-Supply Cords

UL 817.

2.2 CABLE TRAYS

NEMA VE 1 cable trays shall form a wireway system, and shall be of nominal 4 inch depth. Cable trays shall be constructed of zinc-coated steel. Trays shall include splice and end plates, dropouts, and miscellaneous hardware. Edges, fittings, and hardware shall be finished free from burrs and sharp edges. Fittings shall have not less than the load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius. Radius of bends shall be 12 inches.

2.2.1 Ladder

Ladder-type cable trays shall be of nominal 24 inch width. Rung spacing shall be on 9 inch maximum centers.

2.2.2 Channel

Channel-type cable trays shall be 4 inch width. Trays shall be one-piece construction having slots spaced not more than 4-1/2 inches on centers.

2.2.3 Cantilever

Cantilever-type, center-hung cable trays may be provided at the Contractor's option in lieu of other cable tray types specified.

2.3 TRANSIENT VOLTAGE SURGE PROTECTION

Transient voltage surge suppressors shall be provided as indicated. Surge suppressors shall meet the requirements of IEEE C62.41 and be UL listed and labeled as having been tested in accordance with UL 1449. Surge suppressor ratings shall be for the operating voltage on the system indicated, 60 Hz; 3-phase; wire with ground. Fuses shall not be used as surge suppression.

2.4 CIRCUIT BREAKERS

2.4.1 MOLDED-CASE CIRCUIT BREAKERS

Molded-case circuit breakers shall conform to NEMA AB 1 and UL 489 and UL 877 for circuit breakers and circuit breaker enclosures located in hazardous (classified) locations. Circuit breakers may be installed in panelboards, switchboards, enclosures, motor control centers, or combination motor controllers.

2.4.1.1 Construction

Circuit breakers shall be suitable for mounting and operating in any position. Lug shall be listed for copper conductors only in accordance with UL 486E. Single-pole circuit breakers shall be full module size with not more than one pole per module. Multi-pole circuit breakers shall be of the common-trip type having a single operating handle such that an overload or short circuit on any one pole will result in all poles opening simultaneously. Sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multi-pole unit having an internal, mechanical, nontamperable common-trip mechanism and external handle ties. All circuit breakers shall have a quick-make, quick-break overcenter toggle-type mechanism, and the handle mechanism shall be trip-free to prevent holding the contacts closed against a short-circuit or sustained overload. All circuit breaker handles shall assume a position between "ON" and "OFF" when tripped automatically. All ratings shall be clearly visible.

2.4.1.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. The interrupting rating of the circuit breakers shall be at least equal to the available short-circuit current at the line terminals of the circuit breaker and correspond to the UL listed integrated short-circuit current rating specified for the panelboards and switchboards. Molded-case circuit breakers shall have nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings in accordance with NEMA AB 1. Ratings shall be coordinated with system X/R ratio.

2.4.1.3 Cascade System Ratings

Circuit breakers used in series combinations shall be in accordance with UL 489. Equipment, such as switchboards and panelboards, which house series-connected circuit breakers shall be clearly marked accordingly. Series combinations shall be listed in the UL Recognized Component Directory under "Circuit Breakers-Series Connected."

2.4.1.4 Thermal-Magnetic Trip Elements

Thermal magnetic circuit breakers shall be provided as shown. Automatic operation shall be obtained by means of thermal-magnetic tripping devices located in each pole providing inverse time delay and instantaneous circuit protection. The instantaneous magnetic trip shall be adjustable and accessible from the front of all circuit breakers on frame sizes above 200 amperes.

2.4.2 Solid-State Trip Elements

Solid-state circuit breakers shall be provided as shown. All electronics shall be self-contained and require no external relaying, power supply, or accessories. Printed circuit cards shall be treated to resist moisture absorption, fungus growth, and signal leakage. All electronics shall be housed in an enclosure which provides protection against arcs, magnetic interference, dust, and other contaminants. Solid-state sensing shall measure true RMS current with error less than one percent on systems with distortions through the 13th harmonic. Peak or average actuating devices are not acceptable. Current sensors shall be torodial construction, encased in a plastic housing filled with epoxy to protect against damage and moisture and shall be integrally mounted on the breaker. Where indicated on the drawings, circuit breaker frames shall be rated for 100 percent continuous duty. Circuit breakers shall have tripping features as shown on the drawings and as described below:

- a. Long-time current pick-up, adjustable from 50 percent to 100 percent of continuous current rating.
- b. Adjustable long-time delay.
- c. Short-time current pick-up, adjustable from 1.5 to 9 times long-time current setting.
- d. Adjustable short-time delay.
- e. Instantaneous current pick-up, adjustable from 1.5 to 9 times long-time current setting.
- f. Ground-fault pick-up, adjustable from 20 percent to 60 percent of sensor rating, but in no case greater than 1200 amperes. Sensing of ground-fault current at the main bonding jumper or ground strap shall not be permitted.
- g. Adjustable ground-fault delay.
- h. Trip indicators shall be provided.

2.4.3 SWD Circuit Breakers

Circuit breakers rated 15 amperes and intended to switch 277 volts or less fluorescent lighting loads shall be marked "SWD."

2.4.4 HACR Circuit Breakers

Circuit breakers 60 amperes or below, 240 volts, 1-pole or 2-pole, intended to protect multi-motor and combination-load installations involved in heating, air conditioning, and refrigerating equipment shall be marked "Listed HACR Type."

2.4.5 Low-Voltage Power

a. Construction:

Low-voltage power circuit breakers shall conform to IEEE C37.13, ANSI C37.16, and NEMA SG 3 and shall be three-pole, single-throw, stored energy, manually operated (unless indicated otherwise), with drawout mounting. Solid-state trip elements which require no external power connections shall be provided. Circuit breakers shall have an open/close contact position indicator, charged/discharged stored energy indicator, primary disconnect devices, and a mechanical interlock to prevent making or breaking contact of the primary disconnects when the circuit breaker is closed. Control voltage shall be as indicated. The circuit breaker enclosure shall be suitable for its intended location.

b. Ratings:

Voltage ratings shall be not less than the applicable circuit voltage. Circuit breakers shall be rated for 100 percent continuous duty and shall have trip current ratings and frame sizes as shown. Nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings shall be in accordance with ANSI C37.16. Tripping features shall be as follows:

(1) Long-time current pick-up, adjustable from 50 percent to 100 percent of sensor current rating.

(2) Adjustable long-time delay.

(3) Short-time current pick-up, adjustable from 1.5 to 9 times long-time current setting.

(4) Adjustable short-time delay.

(5) Instantaneous current pick-up, adjustable from 1.5 to 9 times long-time current setting.

(6) Ground-fault pick-up, adjustable from 20 percent to 60 percent of sensor rating, but in no case greater than 1200 amperes. Sensing of ground-fault current at the main bonding jumper or ground strap shall not be permitted.

(7) Adjustable ground-fault delay.

(8) Trip indicators shall be provided.

2.4.6 Ground Fault Circuit Interrupters

UL 943. Breakers equipped with ground fault circuit interrupters shall have ground fault class, interrupting capacity, and voltage and current ratings as indicated.

2.5 MOTOR SHORT-CIRCUIT PROTECTOR (MSCP)

Motor short-circuit protectors shall conform to UL 508 and shall be provided as shown. Protectors shall be used only as part of a combination motor controller which provides coordinated motor branch-circuit overload and short-circuit protection, and shall be rated in accordance with the requirements of NFPA 70.

2.5.1 Construction

Motor short-circuit protector bodies shall be constructed of high temperature, dimensionally stable, long life, nonhygroscopic materials. Protectors shall fit special MSCP mounting clips and shall not be interchangeable with any commercially available fuses. Protectors shall have 100 percent one-way interchangeability within the A-Y letter designations. All ratings shall be clearly visible.

2.5.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Letter designations shall be A through Y for motor controller Sizes 0, 1, 2, 3, 4, and 5, with 100,000 amperes interrupting capacity rating. Letter designations shall correspond to controller sizes as follows:

CONTROLLER SIZE	MSCP DESIGNATIONS
NEMA 0	A-N
NEMA 1	A-P
NEMA 2	A-S
NEMA 3	A-U
NEMA 4	A-W
NEMA 5	A-Y

2.6 CONDUIT AND TUBING

2.6.1 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797

2.6.2 Electrical Nonmetallic Tubing (ENT)

NEMA TC 13.

2.6.3 Electrical Plastic Tubing and Conduit

NEMA TC 2.

2.6.4 Flexible Conduit, Steel and Plastic

General-purpose type, UL 1; liquid tight, UL 360, and UL 1660.

2.6.5 Intermediate Metal Conduit

UL 1242.

2.6.6 PVC Coated Rigid Steel Conduit

NEMA RN 1.

2.6.7 Rigid Aluminum Conduit

ANSI C80.5 and UL 6.

2.6.8 Rigid Metal Conduit

UL 6.

2.6.9 Rigid Plastic

NEMA TC 2, UL 651 and UL 651A.

2.6.10 Surface Metal Electrical Raceways and Fittings

UL 5.

2.7 CONDUIT AND DEVICE BOXES AND FITTINGS

2.7.1 Boxes, Metallic Outlet

NEMA OS 1 and UL 514C.

2.7.2 Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers

NEMA OS 2 and UL 514C.

2.7.3 Boxes, Outlet for Use in Hazardous (Classified) Locations

UL 886.

2.7.4 Boxes, Switch (Enclosed), Surface-Mounted

UL 98.

2.7.5 Fittings for Conduit and Outlet Boxes

UL 514B.

2.7.6 Fittings For Use in Hazardous (Classified) Locations

UL 886.

2.7.7 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.8 CONDUIT COATINGS PLASTIC RESIN SYSTEM

NEMA RN 1, Type A-40.

2.9 CONNECTORS, WIRE PRESSURE

2.9.1 For Use With Copper Conductors

UL 486A.

2.9.2 For Use With Aluminum Conductors

UL 486B.

2.10 ELECTRICAL GROUNDING AND BONDING EQUIPMENT

UL 467.

2.10.1 Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467 not less than 5/8 inch in diameter by 10 feet in length of the sectional type driven full length into the earth.

2.10.2 Ground Bus

The ground bus shall be bare conductor or flat copper in one piece, if practicable.

2.11 ENCLOSURES

NEMA ICS 6 or NEMA 250 unless otherwise specified.

2.11.1 Cabinets and Boxes

Cabinets and boxes with volume greater than 100 cubic inches shall be in accordance with UL 50, hot-dip, zinc-coated, if sheet steel.

2.11.2 Circuit Breaker Enclosures

UL 489.

2.11.3 Circuit Breaker Enclosures for Use in Hazardous (Classified) Locations

UL 877.

2.12 FIXTURES, LIGHTING AND FIXTURE ACCESSORIES/COMPONENTS (seyf)

Standard Drawing 40-06-04 sheets referenced hereinafter and enclosed as an integral part of these specifications, additional fixtures shown on contract drawings, if any, and UL 844 for fixtures to be installed in hazardous (classified) locations. Fixtures, accessories and components, including

ballasts, lampholders, lamps, starters and starter holders, shall conform to industry standards specified below.

2.12.1 Fixture, Auxiliary or Emergency

UL 924.

2.12.2 Incandescent Fixture

NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1571.

2.12.3 Fluorescent

a. Fixture: NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1570. Fixtures shall be plainly marked for proper lamp and ballast type to identify lamp diameter, wattage, color and start type. Marking shall be readily visible to service personnel, but not visible from normal viewing angles.

b. Ballasts:

(1) Magnetic ballast, energy-saving, high power factor, Class P, automatic-resetting Type, approved for the application by the Certified Ballast Manufacturers: ANSI C82.1 and UL 935. Two-lamp ballasts shall be used for each pair of lamps within a fixture or within continuous mounted fixtures. Single-lamp ballasts shall be used for individually mounted single-lamp fixtures and where an odd single-lamp fixture occurs at the end of a continuous group. Magnetic fluorescent lamp ballasts shall have a Ballast Efficacy Factor (BEF) not less than shown in the following table:

MAGNETIC FLUORESCENT BALLAST EFFICACY FACTORS

Design starting temperature above 40 degrees F with 60 Hz input frequency

NUMBER OF LAMPS	LAMP TYPE	NOMINAL OPERATIONAL INPUT VOLTAGE	MAX. LAMP OPERATING CURRENT	MIN. BALLAST EFFICACY FACTOR
1	4 ft rapid start	120 or 277	less than 1000 m amp	1.805
2	4 ft rapid start	120	less than 1000 m amp	1.060
2	4 ft rapid start	277	less than 1000 m amp	1.050

2	8 ft slim-line	120 - 277	less than 1000 m amp	0.570
2	8 ft high output, rapid start	120 - 277	less than 1000 m amp	0.390

* For ballasts not specifically designed for use with dimming controls

The BEF is calculated using the formula:

BEF = Ballast Factor, (in percent) / Power Input

Where Power Input = Total Wattage of Combined Lamps and Ballasts.

(2) Electronic Ballast. Electronic ballasts shall consist of a rectifier, high frequency inverter, and power control and regulation circuitry. The ballasts shall be UL listed, Class P, with a Class A sound rating and shall contain no PCBs. Ballasts shall meet 47 CFR 18 for electromagnetic interference and shall not interfere with the operation of other electrical equipment. Design shall withstand line transients per IEEE C62.41, Category A. Unless otherwise indicated, the minimum number of ballasts shall be used to serve each individual fixture, using one, two, three or four lamp ballasts. A single ballast may be used to serve multiple fixtures if they are continuous mounted, factory manufactured for that installation with an integral wireway, and are identically controlled.

(a) Light output regulation shall be +/- 10%.

(b) Voltage input regulation shall be +/- 10%.

(c) Lamp current crest factor shall be no more than 1.6.

(d) Ballast factor shall be not less than 85% nor more than 100%, unless otherwise indicated.

(e) A 60 Hz filter shall be provided. Flicker shall be no more than 10% with any lamp suitable for the ballast.

(f) Ballast case temperature shall not exceed 25 degree Celsius rise above 40 degree Celsius ambient, when tested in accordance with UL 935.

(g) Total harmonic distortion shall be in the range of 10-20%.

(h) Power factor shall not be less than 0.95.

(i) Ballasts shall operate at a frequency of 20 kHz or more.

(j) Operating filament voltage shall be 2.5 to 4.5 volts.

(k) Warranty. Three year full warranty including a \$10 labor allowance.

(1) Ballast Efficacy Factor (BEF) shall be in accordance with the following table. Ballasts and lamps shall be matching rapid start or instant start as indicated on the following table. If 32W-F32-T8 lamps and ballasts are used, they must be either all rapid start or all instant start.

ELECTRONIC FLUORESCENT BALLAST EFFICACY FACTORS

LAMP TYPE	TYPE OF STARTER & LAMP	NOMINAL OPERATIONAL INPUT VOLTAGE	NUMBER OF LAMPS	MIN. BALLAST EFFICACY FACTOR
40W F40 T12	rapid start	120 or 277 V	1	2.3
			2	1.2
			3	0.8
			4	0.6
34W F40 T12	rapid start	120 or 277 V	1	2.6
			2	1.3
			3	1.0
			4	0.7
40W F40 T10	rapid start	120 or 277 V	1	2.2
			2	1.1
			3	0.8
32W F32 T8	rapid or instant start	120 or 277 V	1	2.4
			2	1.4
			3	1.0
			4	0.8

*For ballasts not specifically designed for use with dimming controls

The BEF is calculated using the formula:

BEF = Ballast Factor (in percent) / Power Input

Where Power Input = Total Wattage of Combined Lamps and Ballasts.

c. Lampholders, Starters, and Starter Holders: UL 542.

2.12.4 High-Intensity-Discharge

a. Fixture: NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1572.

b. Ballasts: ANSI C82.4 for multiple supply types and UL 1029.

2.13 LOW-VOLTAGE FUSES AND FUSEHOLDERS

2.13.1 Fuses, Low Voltage Cartridge Type

NEMA FU 1.

2.13.2 Fuses, High-Interrupting-Capacity, Current-Limiting Type

Fuses, Class G, J, L and CC shall be in accordance with UL 198C.

2.13.3 Fuses, Class K, High-Interrupting-Capacity Type

UL 198D.

2.13.4 Fuses, Class H

UL 198B.

2.13.5 Fuses, Class R

UL 198E.

2.13.6 Fuses, Class T

UL 198H.

2.13.7 Fuses for Supplementary Overcurrent Protection

UL 198G.

2.13.8 Fuses, D-C for Industrial Use

UL 198L.

2.13.9 Fuseholders

UL 512.

2.14 INSTRUMENTS, ELECTRICAL INDICATING

ANSI C39.1.

2.15 MOTORS, AC, FRACTIONAL AND INTEGRAL

Motors, ac, fractional and integral horsepower, 500 hp and smaller shall conform to NEMA MG 1 and UL 1004 for motors; NEMA MG 10 for energy management selection of polyphase motors; and UL 674 for use of motors in hazardous (classified) locations.

2.15.1 Rating

The horsepower rating of motors should be limited to no more than 125 percent of the maximum load being served unless a NEMA standard size does not fall within this range. In this case, the next larger NEMA standard motor size should be used.

2.15.2 Motor Efficiencies

All permanently wired polyphase motors of 1 hp or more shall meet the minimum full-load efficiencies as indicated in the following table, and as specified in this specification. Motors of 1 hp or more with open, drip proof or totally enclosed fan cooled enclosures shall be high efficiency type, unless otherwise indicated. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or overall efficiency requirement is indicated for that equipment by the provisions of another section.

Minimum Motor Efficiencies

HP	Std. Efficiency	High Efficiency
1	77.0	85.5
1.5	78.5	85.5
2	78.5	85.5
3	78.5	88.5
5	82.5	88.5
7.5	84.0	90.0
10	85.5	90.0
15	85.5	91.0
20	87.5	92.0
25	88.5	92.0
30	88.5	92.0
40	88.5	92.0
50	89.0	92.5
60	89.0	92.5
75	89.0	95.5
100	90.0	93.5
125	91.0	94.5
150	91.0	94.5
200	91.0	94.5
250	91.0	94.5
300	91.0	94.5
350	91.0	94.5
400	91.0	94.5
500	91.0	94.5

2.16 MOTOR CONTROLS AND MOTOR CONTROL CENTERS**2.16.1 General**

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845. Panelboards supplying non-linear loads shall have neutrals sized for 200 percent of rated current.

2.16.2 Motor Starters

Combination starters shall be provided with circuit breakers.

2.16.3 Thermal-Overload Protection

Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating.

2.16.4 Low-Voltage Motor Overload Relays

2.16.4.1 General

Thermal overload relays shall conform to NEMA ICS 2 and UL 508. Overload protection shall be provided either integral with the motor or motor controller, and shall be rated in accordance with the requirements of NFPA 70. Standard units shall be used for motor starting times up to 7 seconds.

2.16.4.2 Construction

Manual reset type thermal relay shall be bimetallic construction. Automatic reset type thermal relays shall be bimetallic construction. Magnetic current relays shall consist of a contact mechanism and a dash pot mounted on a common frame.

2.16.4.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Trip current ratings shall be established by selection of the replaceable overload device and shall not be adjustable. Where the controller is remotely-located or difficult to reach, an automatic reset, non-compensated overload relay shall be provided. Manual reset overload relays shall be provided otherwise, and at all locations where automatic starting is provided. Where the motor is located in a constant ambient temperature, and the thermal device is located in an ambient temperature that regularly varies by more than minus 18 degrees F, an ambient temperature-compensated overload relay shall be provided.

2.16.5 Automatic Control Devices

2.16.5.1 Direct Control

Automatic control devices (such as thermostats, float or pressure switches) which control the starting and stopping of motors directly shall be designed for that purpose and have an adequate horsepower rating.

2.16.5.2 Pilot-Relay Control

Where the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit.

2.16.5.3 Manual/Automatic Selection

a. Where combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch (marked MANUAL-OFF-AUTOMATIC) shall be provided for the manual control.

b. Where combination manual and automatic control is specified and the automatic-control device actuates the pilot control circuit of a magnetic starter, the magnetic starter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC.

c. Connections to the selector switch shall be such that; only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low-or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

2.17 PANELBOARDS

Dead-front construction, NEMA PB 1 and UL 67.

2.18 RECEPTACLES

2.18.1 Heavy Duty Grade

NEMA WD 1. Devices shall conform to all requirements for heavy duty receptacles.

2.18.2 Standard Grade

UL 498.

2.18.3 Ground Fault Interrupters

UL 943, Class A or B.

2.18.4 Hazardous (Classified) Locations

UL 1010.

2.18.5 NEMA Standard Receptacle Configurations

NEMA WD 6.

a. Single and Duplex, 15-Ampere and 20-Ampere, 125 Volt 15-ampere, non-locking: NEMA type 5-15R, locking: NEMA type L5-15R, 20-ampere, non-locking: NEMA type 5-20R, locking: NEMA type L5-20R.

b. 15-Ampere, 250 Volt: Two-pole, 3-wire grounding, non-locking: NEMA type 6-15R, locking: NEMA type L6-15R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-15R, locking: NEMA type L15-15R.

c. 20-Ampere, 250 Volt: Two-pole, 3-wire grounding, non-locking: NEMA type 6-20R, locking: NEMA type L6-20R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-20R, locking: NEMA type L15-20R.

d. 30-Ampere, 125/250 Volt: Three-pole, 3-wire, non-locking: NEMA type 10-30R, locking: NEMA type L10-30R. Three-pole, 4-wire grounding, non-locking: NEMA type 14-30R, locking: NEMA type L14-30R.

e. 30-Ampere, 250 Volt: Two-pole, 3-wire grounding, non-locking: NEMA type 6-30R, locking: NEMA type L6-30R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-30R, locking: NEMA type L15-30R.

f. 50-Ampere, 125/250 Volt: Three-pole, 3-wire: NEMA type 10-50R. Three-pole, 4-wire grounding: NEMA type 14-50R.

g. 50-Ampere, 250 Volt: Two-pole, 3-wire grounding: NEMA type 6-50R. Three-pole, 4-wire grounding: NEMA type 15-50R.

2.19 Service Entrance Equipment

UL 869A.

2.20 SPLICE, CONDUCTOR

UL 486C.

2.21 SNAP SWITCHES

UL 20.

2.22 TAPES

2.22.1 Plastic Tape

UL 510.

2.22.2 Rubber Tape

UL 510.

2.23 TRANSFORMERS

Single- and three-phase transformers shall have two windings per phase. Full-capacity standard NEMA taps shall be provided in the primary windings of transformers unless otherwise indicated. Three-phase transformers shall be configured with delta-wye windings, except as indicated.

2.23.1 Transformers, Dry-Type

Transformers shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation system for transformers rated 10 kVA and less, with temperature rise not exceeding 150 degrees C under full-rated load in maximum ambient temperature of 40 degrees C. Transformer of 150 degrees C temperature rise shall be capable of carrying

continuously 100 percent of nameplate kVA without exceeding insulation rating.

a. 600 Volt or Less Primary:

NEMA ST 20, UL 506, general purpose, dry-type, self-cooled, ventilated. Provide transformers in NEMA 1 enclosure, unless indicated otherwise. Transformers shall be quiet type with maximum sound level at least 3 decibels less than NEMA standard level for transformer ratings indicated.

2.23.2 Liquid-Insulated Transformers

IEEE C57.12.00, ANSI C57.12.10, ANSI C57.12.13, ANSI C57.12.27, ANSI C57.12.70, IEEE C57.12.80, IEEE C57.12.90, IEEE C57.98, and IEEE C57.100. Transformers may be the mineral-oil insulated, silicone, or the high-molecular weight hydrocarbon (HMWH) type. Voltage and KVA ratings shall be as indicated. Pressure relief valves and relays required for safe operation in an interior location or vault shall be provided. Single kVA ratings shown are based on self-cooled operation. Temperature rise shall not exceed 55/65 degrees C under full load operation in an ambient temperature of 40 degrees C. Percent voltage impedance shall be manufacturer's standard, unless indicated otherwise. The basic impulse insulation level (BIL) rating shall be not less than 110 kV for the distribution voltage shown. Nameplates shall be provided in accordance with IEEE C57.12.00.

2.23.3 Average Sound Level

The average sound level in decibels (dB) of transformers shall not exceed the following dB level at 12 inches for the applicable kVA rating range listed unless otherwise indicated:

kVA Range	dB Sound Level
1-50	50
51-150	55
151-300	58
301-500	60
501-700	62
701-1000	64
1001-1500	65
1501 & above	70

2.24 ISOLATED POWER SYSTEM EQUIPMENT

UL 1047, with monitor UL 1022.

2.25 INSTRUMENT TRANSFORMERS

2.25.1 General

Instrument transformers shall comply with ANSI C12.11 and IEEE C57.13. Instrument transformers shall be configured for mounting in/on the device to which they are applied. Polarity marks on instrument transformers shall be visually evident and shown on drawings.

2.25.2 Current Transformers

Unless otherwise indicated, bar, wound, or window-type transformers are acceptable; and except for window-type units installed over insulated buses, transformers shall have a BIL rating consistent with the rated BIL of the associated switchgear or electric power apparatus bushings, buses or conductors. Current transformers shall have the indicated ratios. The continuous thermal-current rating factor shall be not less than 1.2. Other thermal and mechanical ratings of current transformer and their primary leads shall be coordinated with the design of the circuit breaker and shall be not less than the momentary rating of the associated circuit breaker. Circuit protectors shall be provided across secondary leads of the current transformers to prevent the accidental open-circuiting of the transformers while energized. Each terminal of each current transformer shall be connected to a short-circuiting terminal block in the circuit interrupting mechanism cabinet, power transformer terminal cabinet, and in the associated instrument and relay cabinets.

2.25.2.1 Current Transformers for kWh and Demand Metering (Low Voltage)

Current transformers shall conform to IEEE C57.13. Provide current transformers with a metering accuracy Class of 0.3, with a minimum RF as indicated, at 30 degrees C, with 600-volt insulation, and 10 kV BIL. Provide butyl-molded, window-type current transformers mounted in the current transformer cabinet.

2.26 WIRING DEVICES

NEMA WD 1 for wiring devices, and NEMA WD 6 for dimensional requirements of wiring devices.

PART 3 - EXECUTION

3.1 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following specifications.

3.1.1 Ground Rods

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground shall not exceed 10 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, 2 additional rods not less than 6 feet on centers may be coupled and driven with the first rod. In high-ground-resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 10 ohms measured not less than 24 hours after rainfall, the Contracting Officer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.1.2 Ground Bus

Ground bus shall be provided in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of electrical equipment shall be effectively grounded by bonding to the ground bus. The ground bus shall be bonded to both the entrance ground, and to a ground rod or rods as specified above. All below ground or sealed connections shall be thermoweld exothermic type connections. Above ground exposed connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment. For raised floor equipment rooms in computer and data processing centers, a minimum of 4, one at each corner, multiple grounding systems shall be furnished. Connections shall be bolted type in lieu of thermoweld, so they can be changed as required by additions and/or alterations.

3.1.3 Grounding Conductors

A green equipment grounding conductor, sized in accordance with NFPA 70 shall be provided, regardless of the type of conduit. Equipment grounding bars shall be provided in all panelboards. The equipment grounding conductor shall be carried back to the service entrance grounding connection or separately derived grounding connection. All equipment grounding conductors, including metallic raceway systems used as such, shall be bonded or joined together in each wiring box or equipment enclosure. Metallic raceways and grounding conductors shall be checked to assure that they are wired or bonded into a common junction. Metallic boxes and enclosures, if used, shall also be bonded to these grounding conductors by an approved means per NFPA 70. When boxes for receptacles, switches, or other utilization devices are installed, any designated grounding terminal on these devices shall also be bonded to the equipment grounding conductor junction with a short jumper.

3.2 WIRING METHODS

Wiring shall conform to NFPA 70, the contract drawings, and the following specifications. Unless otherwise indicated, wiring shall consist of insulated conductors installed in rigid zinc-coated steel conduit or electrical metallic tubing or intermediate metal conduit. Where cables and wires are installed in cable trays, they shall be of the type permitted by NFPA 70 for use in such applications. Wire fill in conduits shall be based on NFPA 70 for the type of conduit and wire insulations specified. Wire fill in conduits located in Class I or II hazardous areas shall be limited to 25 percent of the cross sectional area of the conduit.

3.2.1 Conduit and Tubing Systems

Conduit and tubing systems shall be installed as indicated. Conduit sizes shown are based on use of copper conductors with insulation types as described in paragraph WIRING METHODS. Minimum size of raceways shall be 1/2 inch. Only metal conduits will be permitted unless specifically stated otherwise.

All conduits shall be installed per the requirements and criteria given in NFPA 70. Nonmetallic conduit and tubing may be used in damp, wet or corrosive locations when permitted by NFPA 70 and the conduit or tubing system is provided with appropriate boxes, covers, clamps, screws or other appropriate type of fittings. Electrical metallic tubing (EMT) may be installed only

within buildings, above the floor level. EMT may be installed in concrete and grout in dry locations. EMT installed in concrete or grout shall be provided with concrete tight fittings. EMT shall not be installed in damp or wet locations, or the air space of exterior masonry cavity walls. Bushings, manufactured fittings or boxes providing equivalent means of protection shall be installed on the ends of all conduits and shall be of the insulating type, where required by NFPA 70. Only UL listed adapters shall be used to connect EMT to rigid metal conduit, cast boxes, and conduit bodies. Aluminum conduit may not be used unless specifically indicated otherwise. Nonaluminum sleeves shall be used where aluminum conduit passes through concrete floors and firewalls. Penetrations of above grade floor slabs, time-rated partitions and fire walls shall be firestopped as specified in accordance with Section 07840 - FIRESTOPPING. Except as otherwise specified, IMC may be used as an option for rigid steel conduit in areas as permitted by NFPA 70. Raceways shall not be installed under the firepits of boilers and furnaces and shall be kept 6 inches away from parallel runs of flues, steam pipes and hot-water pipes. Raceways shall be concealed within finished walls, ceilings, and floors unless otherwise shown. Raceways crossing structural expansion joints or seismic joints shall be provided with suitable expansion fittings or other suitable means to compensate for the building expansion and contraction and to provide for continuity of grounding. Wiring installed in underfloor duct system or underfloor raceway system shall be suitable for installation in wet locations.

3.2.1.1 Pull Wires

A pull wire shall be inserted in each empty raceway in which wiring is to be installed if the raceway is more than 25 feet in length and contains more than the equivalent of two 90-degree bends. The pull wire shall be of No. 14 AWG zinc-coated steel, or of plastic having not less than 200 pounds per square inch tensile strength. Not less than 254 mm 10 inches of slack shall be left at each end of the pull wire.

3.2.1.2 Conduit Stub-Ups

Where conduits are to be stubbed up through concrete floors, a short elbow shall be installed below grade to transition from the horizontal run of conduit to a vertical run. A conduit coupling fitting, threaded on the inside shall be installed, to allow terminating the conduit flush with the finished floor. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used 6 inches above the floor. Empty or spare conduit stub-ups shall be plugged flush with the finished floor with a threaded, recessed plug.

3.2.1.3 Below Slab-on-Grade or in the Ground

Electrical wiring below slab-on-grade shall be protected by a conduit system. Conduit passing vertically through slabs-on-grade shall be rigid steel or IMC. Rigid steel or IMC conduits installed below slab-on-grade or in the earth shall be field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating system.

3.2.1.4 Installing in Slabs Including Slabs on Grade

Conduit installed in slabs-on-grade shall be rigid steel or IMC. Conduits shall be installed as close to the middle of concrete slabs as practicable without disturbing the reinforcement. Outside diameter shall not exceed 1/3 of the slab thickness and conduits shall be spaced not closer than 3 diameters on centers except at cabinet locations where the slab thickness shall be increased as approved by the Contracting Officer. Where conduit is run parallel to reinforcing steel, the conduit shall be spaced a minimum of one conduit diameter away but not less than one inch from the reinforcing steel.

3.2.1.5 Changes in Direction of Runs

Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Care shall be taken to prevent the lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment during the course of construction. Clogged raceways shall be cleared of obstructions or shall be replaced.

3.2.1.6 Supports

Except where otherwise permitted by NFPA 70, conduits and tubing shall be securely and rigidly fastened in place at intervals of not more than 10 feet and within 3 feet of boxes, cabinets, and fittings, with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps, beam clamps, or ceiling trapeze. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structure. Loads shall not be applied to joist bridging. Attachment shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or pipe straps shall not be welded to steel structures. Cutting the main reinforcing bars in reinforced concrete beams or joists shall be avoided when drilling holes for support anchors. Holes drilled for support anchors, but not used, shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Raceways shall not be supported using wire or nylon ties. Raceways shall be independently supported from the structure. Upper raceways shall not be used as a means of support for lower raceways. Supporting means will not be shared between electrical raceways and mechanical piping or ducts. Cables and raceways shall not be supported by ceiling grids. Except where permitted by NFPA 70, wiring shall not be supported by ceiling support systems. Conduits shall be fastened to sheet-metal boxes and cabinets with two locknuts where required by NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered. Additional support for horizontal runs is not required when EMT rests on steel stud cutouts.

3.2.1.7 Exposed Raceways

Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Raceways under raised floors and above accessible ceilings shall be considered as exposed installations in accordance with NFPA 70 definitions.

3.2.1.8 Exposed Risers

Exposed risers in wire shafts of multistory buildings shall be supported by U-clamp hangers at each floor level, and at intervals not to exceed 10 feet.

3.2.1.9 Exposed Lengths of Conduit, Over 600 Volts

Exposed lengths of conduit containing power conductors operating at more than 600 volts shall have two red bands 2 inches wide spaced 8 inches apart painted near each coupling; the intervening space between the red bands shall be painted white, and on the white space the voltage shall be stenciled in black.

3.2.1.10 Communications Raceways

Communications raceways indicated shall be installed in accordance with the previous requirement for conduit and tubing and with the additional requirement that no length of run shall exceed 50 feet for 1/2 inch and 3/4 inch sizes, and 100 feet for 1 inch size or larger.

3.2.2 Cable Trays

Cable trays shall be supported in accordance with the recommendations of the manufacturer but at no more than 6 foot intervals. Contact surfaces of aluminum connections shall be coated with an antioxidant compound prior to assembly. Adjacent cable tray sections shall be bonded together by connector plates of an identical type as the cable tray sections. The Contractor shall submit the manufacturer's certification that the cable tray system meets all requirements of Article 318 of NFPA 70. The cable tray shall be installed and grounded in accordance with the provisions of Article 318 of NFPA 70. Data submitted by the Contractor shall demonstrate that the completed cable tray systems will comply with the specified requirements. Cable trays shall terminate 10 inches from both sides of smoke and fire partitions. Conductors run through smoke and fire partitions shall be installed in 4 inch rigid steel conduits with grounding bushings, extending 12 inches beyond each side of the partitions. The installation shall be sealed to preserve the smoke and fire rating of the partitions.

3.2.3 Cables and Conductors

Installation shall conform to the requirements of NFPA 70. Covered, bare or insulated conductors of circuits rated over 600 volts shall not occupy the same equipment wiring enclosure, cable, or raceway with conductors of circuits rated 600 volts or less.

3.2.3.1 Sizing

Unless otherwise noted, all sizes are based on copper conductors and the insulation types indicated. Sizes shall be not less than indicated. Branch-circuit conductors shall be not smaller than No. 12 AWG. Conductors for branch circuits of 120 volts more than 100 feet long and of 277 volts more than 230 feet long, from panel to load center, shall be no smaller than No. 10 AWG. Class 1 remote control and signal circuit conductors shall be not less than No. 14 AWG. Class 2 remote control and signal circuit conductors shall be not less than No. 16 AWG. Class 3 low-energy, remote-control and signal circuits shall be not less than No. 22 AWG.

3.2.3.2 Use of Aluminum Conductors in Lieu of Copper

Aluminum conductors shall not be used.

3.2.3.3 Cable Systems

Cable systems shall be installed where indicated. Cables shall be installed concealed behind ceiling or wall finish where practicable. Cables shall be threaded through holes bored on the approximate centerline of wood members; notching of surfaces will not be permitted. Sleeves shall be provided through bond beams of masonry-block walls for threading cables through hollow spaces. Exposed cables shall be installed parallel or at right angles to walls or structural members. In rooms or areas not provided with ceiling or wall finish, cables and outlets shall be installed so that a room finish may be applied in the future without disturbing the cables or resetting the boxes. Exposed nonmetallic-sheathed cables less than 4 feet above floors shall be protected from mechanical injury by installation in conduit or tubing.

3.2.3.4 Cable Splicing

Splices shall be made in an accessible location. Crimping tools and dies shall be approved by the connector manufacturer for use with the type of connector and conductor.

a. Copper Conductors, 600 Volt and Under: Splices in conductors No. 10 AWG and smaller diameter shall be made with an insulated, pressure-type connector. Splices in conductors No. 8 AWG and larger diameter shall be made with a solderless connector and insulated with tape or heat-shrink type insulating material equivalent to the conductor insulation.

3.2.3.5 Conductor Identification and Tagging

Power, control, and signal circuit conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation. Phase conductors of low voltage power circuits shall be identified by color coding. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions.

a. Color coding shall be provided for service, feeder, branch, and ground conductors. Color shall be green for grounding conductors and white for

neutrals; except where neutrals of more than one system are installed in the same raceway or box, other neutral shall be white with colored (not green) stripe. The color coding for three-phase and single-phase low voltage systems shall be as follows:

120/208-volt, 3-phase: Black(A), red(B), and blue(C).
277/480-volt, 3-phase: Brown(A), orange(B), and yellow(C).
120/240-volt, 1-phase: Black and red.

b. Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by the use of half-lapped bands of colored electrical tape wrapped around the insulation for a minimum of 3 inches of length near the end, or other method as submitted by the Contractor and approved by the Contracting Officer.

c. Control and signal circuit conductor identification shall be made by color-coded insulated conductors, plastic-coated self-sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved detail drawings. Hand lettering or marking is not acceptable.

3.3 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems where required by NFPA 70 for pulling of wires, making connections, and mounting of devices or fixtures. Pull boxes shall be furnished with screw-fastened covers. Indicated elevations are approximate, except where minimum mounting heights for hazardous areas are required by NFPA 70. Unless otherwise indicated, boxes for wall switches shall be mounted 48 inches above finished floors. Switch and outlet boxes located on opposite sides of fire rated walls shall be separated by a minimum horizontal distance of 24 inches. The total combined area of all box openings in fire rated walls shall not exceed 100 square inches per 100 square feet. Maximum box areas for individual boxes in fire rated walls vary with the manufacturer and must not exceed the maximum specified for that box in UL-03. Only boxes listed in UL-03 shall be used in fire rated walls.

3.3.1 Box Applications

Each box shall have not less than the volume required by NFPA 70 for number of conductors enclosed in box. Boxes for metallic raceways, 4 by 4 inch nominal size and smaller, shall be of the cast-metal hub type when located in normally wet locations, when flush and surface mounted on outside of exterior surfaces, or when located in hazardous areas. Cast-metal boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Boxes for mounting lighting fixtures shall be not less than 4 inches square, or octagonal, except smaller boxes may be installed as required by fixture configuration, as approved. Cast-metal boxes with 3/32 inch wall thickness are acceptable. Large size boxes shall be NEMA 1 or as shown. Boxes in other locations shall be sheet steel except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used

with nonmetallic conduit and tubing or nonmetallic sheathed cable system, when permitted by NFPA 70. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers.

3.3.2 Brackets and Fasteners

Boxes and supports shall be fastened to wood with wood screws or screw-type nails of equal holding strength, with bolts and metal expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screw or welded studs on steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts, or nail-type nylon anchors may be used in lieu of expansion shields, or machine screws. Penetration of more than 1-1/2 inches into reinforced-concrete beams or more than 3/4 inch into reinforced-concrete joists shall avoid cutting any main reinforcing steel. The use of brackets which depend on gypsum wallboard or plasterboard for primary support will not be permitted. In partitions of light steel construction, bar hangers with 1 inch long studs, mounted between metal wall studs or metal box mounting brackets shall be used to secure boxes to the building structure. When metal box mounting brackets are used, additional box support shall be provided on the side of the box opposite the brackets. This additional box support shall consist of a minimum 12 inch long section of wall stud, bracketed to the opposite side of the box and secured by two screws through the wallboard on each side of the stud. Metal screws may be used in lieu of the metal box mounting brackets.

3.3.3 Mounting in Walls, Ceilings, or Recessed Locations

In walls or ceilings of concrete, tile, or other non-combustible material, boxes shall be installed so that the edge of the box is not recessed more than 1/4 inch from the finished surface. Boxes mounted in combustible walls or ceiling material shall be mounted flush with the finished surface. The use of gypsum or plasterboard as a means of supporting boxes will not be permitted. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers, as required. The bottom of boxes installed in masonry-block walls for concealed wiring shall be mounted flush with the top of a block to minimize cutting of the blocks, and boxes shall be located horizontally to avoid cutting webs of block. Separate boxes shall be provided for flush or recessed fixtures when required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided.

3.3.4 Installation in Overhead Spaces

In open overhead spaces, cast-metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast-metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Hangers shall not be fastened to or supported from joist bridging. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type fastener not more than 24 inches from the box.

3.4 DEVICE PLATES

One-piece type device plates shall be provided for all outlets and fittings. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel having rounded or beveled edges. Plates on finished walls shall be of satin finish corrosion resistant steel. Screws shall be of metal with countersunk heads, in a color to match the finish of the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16 inch. The use of sectional-type device plates will not be permitted. Plates installed in wet locations shall be gasketed and provided with a hinged, gasketed cover, unless otherwise specified.

3.5 RECEPTACLES

3.5.1 Single and Duplex, 15 or 20-ampere, 125 volt

Single and duplex receptacles shall be rated 20 amperes, 125 volts, two-pole, three-wire, grounding type with polarized parallel slots. Bodies shall be of ivory or as indicated to match color of switch handles in the same room or to harmonize with the color of the respective wall, and supported by mounting strap having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side- or back-wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke. Switched receptacles shall be the same as other receptacles specified except that the ungrounded pole of each suitable receptacle shall be provided with a separate terminal. Only the top receptacle of a duplex receptacle shall be wired for switching application. Receptacles with ground fault circuit interrupters shall have the current rating as indicated, and shall be UL Class A type unless otherwise shown. Ground fault circuit protection shall be provided as required by NFPA 70 and as indicated on the drawings.

3.5.2 Clock Outlet

Clock outlet, for use in other than a wired clock system, shall consist of an outlet box, a plaster cover where required, and a single receptacle with clock-outlet plate. The receptacle shall be recessed sufficiently within the box to allow the complete insertion of a standard cap, flush with the plate. A suitable clip or support for hanging the clock shall be secured to the top of the plate. Material and finish of the plate shall be as specified in paragraph DEVICE PLATES.

3.5.3 Floor Outlets

Floor outlets shall be nonadjustable and each outlet shall consist of a cast-metal body with threaded openings for conduits, flange ring, and cover plate with 1/2 inch or 3/4 inch threaded flush plug. Each telephone outlet shall consist of a horizontal cast housing with a receptacle as specified. Gaskets shall be used where necessary to ensure a watertight installation. Plugs with installation instructions shall be delivered to the Contracting Officer at the job site for capping outlets upon removal of service fittings.

3.5.4 Weatherproof Applications

Weatherproof receptacles shall be suitable for the environment, damp or wet as applicable, and the housings shall be labeled to identify the allowable use. Receptacles shall be marked in accordance with UL 514A for the type of use indicated; "Damp locations", "Wet Locations", "Wet Location Only When Cover Closed". Assemblies shall be installed in accordance with the manufacturer's recommendations.

3.5.4.1 Damp Locations

Receptacles in damp locations shall be mounted in an outlet box with a gasketed, weatherproof, cast-metal cover plate (device plate, box cover) and a gasketed cap (hood, receptacle cover) over each receptacle opening. The cap shall be either a screw-on type permanently attached to the cover plate by a short length of bead chain or shall be a flap type attached to the cover with a spring loaded hinge.

3.5.4.2 Wet Locations

Receptacles in wet locations shall be installed in an assembly rated for such use whether the plug is inserted or withdrawn, unless otherwise indicated. In a duplex installation, the receptacle cover shall be configured to shield the connections whether one or both receptacles are in use. Assemblies which utilize a self-sealing boot or gasket to maintain wet location rating shall be furnished with a compatible plug at each receptacle location and a sign notifying the user that only plugs intended for use with the sealing boot shall be connected during wet conditions.

3.5.5 Receptacles, 15-Ampere, 250-Volt

Receptacles, 15-ampere, 250-volt, shall be duplex two-pole, three-wire, grounding type with bodies of ivory phenolic compound supported by mounting yoke having plaster ears. The third grounding pole shall be connected to the metal yoke. Each receptacle shall be provided with a mating cord-grip plug.

3.5.6 Receptacles, 20-Ampere, 250-Volt

Receptacles, single, 20-ampere, 250-volt, shall be ivory molded plastic, two-pole, three-wire or three-pole, four-wire, grounding type complete with appropriate mating cord-grip plug.

3.5.7 Receptacles, 30-Ampere, 125/250-Volt

Receptacles, single, 30-ampere, 125/250-volt, shall be molded-plastic, three-pole, four-wire, grounding type, complete with appropriate mating cord-grip type attachment plug. Each dryer receptacle shall be furnished with a non-detachable power supply cord for connection to the electric clothes dryer. The cord shall be an angle-type 36 inch length of Type SRDE range and dryer cable with No. 10 AWG conductors.

3.5.8 Receptacles, 30-Ampere, 250-Volt

Receptacles, single, 30-ampere, 250-volt, shall be molded-plastic, three-pole, three-wire type, complete with appropriate mating cord-grip plug.

3.5.9 Receptacles, 50-Ampere, 125/250-Volt

Receptacles, single 50-ampere, 125/250-volt, shall be flush, molded plastic, three-pole, four-wire, grounding type. Each range receptacle shall be furnished with a nondetachable power supply cord for connection to the electric range. The cord shall be an angle-type 36 inch length of SRDE range and dryer cable with No. 6 AWG conductors.

3.5.10 Receptacles, 50-Ampere, 250-Volt

Receptacles, single, 50-ampere, 250-volt, shall be flush molded plastic, three-pole, three-wire type, complete with appropriate mating cord-grip plug.

3.5.11 Special-Purpose or Heavy-Duty Receptacles

Special-purpose or heavy-duty receptacles shall be of the type and of ratings and number of poles indicated or required for the anticipated purpose. Contact surfaces may be either round or rectangular. One appropriate straight or angle-type plug shall be furnished with each receptacle. Locking type receptacles, rated 30 amperes or less, shall be locked by rotating the plug. Locking type receptacles, rated more than 50 amperes, shall utilize a locking ring.

3.6 WALL SWITCHES

Wall switches shall be of the totally enclosed tumbler type. The wall switch handle and switch plate color shall be ivory. Wiring terminals shall be of the screw type or of the solderless pressure type having suitable conductor-release arrangement. Not more than two switches shall be installed in a single-gang position. Switches shall be rated 20-ampere 120 or 277-volt (as applicable) for use on alternating current only. Pilot lights indicated shall consist of yoke-mounted candelabra-base sockets rated at 75 watts, 125 volts, and fitted with glass or plastic jewels. A clear 6-watt lamp shall be furnished and installed in each pilot switch. Jewels for use with switches controlling motors shall be green, and jewels for other purposes shall be red. Dimming switches shall be solid-state flush mounted, sized for the loads.

3.7 SERVICE EQUIPMENT

Service-disconnecting means shall be of the enclosed molded-case circuit breaker type with an external handle for manual operation. When service disconnecting means is a part of an assembly, the assembly shall be listed as suitable for service entrance equipment. Enclosures shall be sheet metal with hinged cover for surface mounting unless otherwise indicated.

3.8 PANELBOARDS AND LOADCENTERS

Circuit breakers and switches used as a motor disconnecting means shall be capable of being locked in the open position. Door locks shall be keyed alike. Nameplates shall be as approved. Directories shall be typed to indicate loads served by each circuit and mounted in a holder behind a clear protective covering. Busses may be copper or aluminum.

3.8.1 Loadcenters

Loadcenters shall be circuit breaker equipped.

3.8.2 Panelboards

Panelboards shall be circuit breaker equipped as indicated on the drawings.

3.9 FUSES

Equipment provided under this contract shall be provided with a complete set of properly rated fuses when the equipment manufacturer utilize fuses in the manufacture of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting capacity of circuit breakers or equipment to less than the maximum available fault current at the location of the equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and shall have the time-current characteristics required for effective power system coordination.

3.9.1 Cartridge Fuses; Noncurrent-Limiting Type

Cartridge fuses of the noncurrent-limiting type shall be Class H, nonrenewable, dual element, time lag type and shall have interrupting capacity of 10,000 amperes. At 500 percent current, cartridge fuses shall not blow in less than 10 seconds.

3.9.2 Cartridge Fuses; Current-Limiting Type

Cartridge fuses, current-limiting type, class RK1, shall have tested interrupting capacity not less than 200,000 amperes. Fuse holders shall be the type that will reject all Class H fuses.

3.9.3 Motor and Transformer Circuit Fuses

Motor, motor controller, transformer, and inductive circuit fuses shall be Class RK1 or RK5, current-limiting, time-delay with 200,000 amperes interrupting capacity.

3.10 UNDERGROUND SERVICE

Unless otherwise indicated, interior conduit systems shall be stubbed out 5 feet beyond the building wall and 2 feet below finished grade, for interface with the exterior service lateral conduits and exterior communications conduits. Outside conduit ends shall be bushed when used for direct burial service lateral conductors. Outside conduit ends shall be capped or plugged until connected to exterior conduit systems. Underground service lateral conductors will be extended to building service entrance and terminated in accordance with the requirements as indicated on drawings and NFPA 70.

3.11 MOTORS

Each motor shall conform to the hp and voltage ratings indicated, and shall have a service factor and other characteristics that are essential to the proper application and performance of the motors under conditions shown or

specified. Motors supplied from a variable speed drive power source shall be rated for variable speed drive duty. Three-phase motors for use on 3-phase 208-volt systems shall have a nameplate rating of 200 volts. Unless otherwise specified, all motors shall have open frames, and continuous-duty classification based on a 40 degree C ambient temperature reference. Polyphase motors shall be squirrel-cage type, having normal-starting-torque and low-starting-current characteristics, unless other characteristics are specified in other sections of these specifications or shown on contract drawings. The Contractor shall be responsible for selecting the actual horsepower ratings and other motor requirements necessary for the applications indicated. When electrically driven equipment furnished under other sections of these specifications materially differs from the design, the Contractor shall make the necessary adjustments to the wiring, disconnect devices and branch-circuit protection to accommodate the equipment actually installed.

3.12 MOTOR CONTROL

Each motor or group of motors requiring a single control shall be provided under other sections of these specifications with a suitable controller and devices that will perform the functions as specified for the respective motors. Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating. Automatic control devices such as thermostats, float or pressure switches may control the starting and stopping of motors directly, provided the devices used are designed for that purpose and have an adequate horsepower rating. When the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit. When combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch shall be provided for the manual control; when the automatic-control device actuates the pilot control circuit of a magnetic starter, the latter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC. Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low- or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

3.12.1 Reduced-Voltage Controllers

Reduced-voltage controllers shall be provided for polyphase motors where indicated. Reduced-voltage starters shall be of the solid state PWM type unless otherwise indicated.

3.12.2 Contacts

Unless otherwise indicated, contacts in miscellaneous control devices such as float switches, pressure switches, and auxiliary relays shall have current and voltage ratings in accordance with NEMA ICS 2 for rating designation B300.

3.12.3 Safety Controls

Safety controls for boilers shall be connected to a 2-wire, 120 volt grounded circuit supplied from the associated boiler-equipment circuit. Where the boiler circuit is more than 120 volts to ground, safety controls shall be energized through a two-winding transformer having its 120 volt secondary winding grounded. Overcurrent protection shall be provided in the ungrounded secondary conductor and shall be sized for the load encountered.

3.13 MOTOR-DISCONNECT MEANS

Each motor shall be provided with a disconnecting means when required by NFPA 70 even though not indicated. For single-phase motors, a single or double pole toggle switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor rating. Switches shall disconnect all ungrounded conductors.

3.14 TRANSFORMER INSTALLATION

Three-phase transformers shall be connected only in a delta-wye configuration unless indicated otherwise, except isolation transformers having a one-to-one turns ratio. Dry-type transformers shown located within 5 feet of the exterior wall shall be provided in a weatherproof enclosure. Transformers to be located within the building may be provided in the manufacturer's standard, ventilated indoor enclosure designed for use in 40 degrees C ambient temperature, unless otherwise indicated.

3.15 LAMPS AND LIGHTING FIXTURES

Ballasted fixtures shall have ballasts which are compatible with the specific type and rating of lamps indicated and shall comply with the applicable provisions of the publications referenced.

3.15.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed in the fixtures just prior to the completion of the project.

3.15.1.1 Incandescent

Incandescent lamps shall be for 125-volt operation unless otherwise indicated.

3.15.1.2 Fluorescent

Fluorescent lamps for magnetic ballasts shall be as indicated and shall be of a type that will not require starter switches. Lamps shall be of the rapid-start type unless otherwise shown or approved. Fluorescent lamps for electronic ballasts shall be as indicated.

3.15.1.3 High-Intensity-Discharge

High-intensity-discharge lamps shall be the high-pressure sodium type unless otherwise indicated, shown, or approved.

3.15.2 Fixtures (seyf)

Fixtures shall be as shown and shall conform to the following specifications and shall be as detailed on Standard Drawing No. 40-06-04, as indicated on the lighting schedule, which accompany and form a part of this specification for the types indicated. Illustrations shown on these sheets are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar designs and equivalent energy efficiency, light distribution and brightness characteristics, and of equal finish and quality will be acceptable if approved. In suspended acoustical ceilings with fluorescent fixtures, the fluorescent emergency light fixtures shall be furnished with self-contained battery packs.

3.15.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation. Open type fluorescent fixtures with exposed lamps shall have a wire-basket type guard.

3.15.2.2 Suspended Fixtures

Suspended fixtures shall be provided with swivel hangers in order to ensure a plumb installation. Pendants, rods, or chains 4 feet or longer excluding fixture, shall be braced to limit swinging. Bracing shall be 3 directional, 120 degrees apart. Single unit suspended fluorescent fixtures shall have twin-stem hangers. Multiple unit or continuous-row fluorescent units shall have a tubing or stem for wiring at one point, and a tubing or rod suspension provided for each length of chassis including one at each end. Maximum distance between adjacent tubing or stems shall be 10 feet. Rods shall be of not less than 3/16 inch diameter. Flexible raceway shall be installed to each fixture from an overhead junction box. Fixture to fixture wiring installation is allowed only when fixtures are installed end to end in a continuous run.

3.15.2.3 Ceiling Fixtures

Ceiling fixtures shall be coordinated with and suitable for installation in, on, or from the suspended ceiling provided under other sections of these specifications. Installation and support of fixtures shall be in accordance with the NFPA 70 and manufacturer's recommendations. Recessed fixtures shall have adjustable fittings to permit alignment with ceiling panels. Recessed fixtures installed in fire-resistive type of suspended ceiling construction shall have the same fire rating as the ceiling or shall be provided with

fireproofing boxes having materials of the same fire rating as the ceiling panels, in conformance with UL-03. Surface-mounted fixtures shall be suitable for fastening to the structural support for ceiling panels.

3.15.2.4 Sockets

Sockets of industrial, strip, and other open type fluorescent fixtures shall be of the type requiring a forced movement along the longitudinal axis of the lamp for insertion and removal of the lamp.

3.15.3 Emergency Light Sets

Emergency light sets shall conform to UL 924 with the number of heads as indicated. Sets shall be permanently connected to the wiring system by conductors installed in short lengths of flexible conduit.

3.16 EQUIPMENT CONNECTIONS

All wiring not furnished and installed under other sections of the specifications for the connection of electrical equipment as indicated on the drawings shall be furnished and installed under this section of the specifications. Connections shall comply with the applicable requirements of paragraph WIRING METHODS. Flexible conduits 6 feet or less in length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. All motors shall be provided with separate grounding conductors. Liquid-tight conduits shall be used in damp or wet locations.

3.16.1 Motors and Motor Control

Motors, motor controls, and motor control centers shall be installed in accordance with NFPA 70, the manufacturer's recommendations, and as indicated. Wiring shall be extended to motors, motor controls, and motor control centers and terminated.

3.16.2 Installation of Government-Furnished Equipment

Wiring shall be extended to the equipment and connected.

3.17 CIRCUIT PROTECTIVE DEVICES

The Contractor shall calibrate, adjust, set and test each new adjustable circuit protective device to ensure that they will function properly prior to the initial energization of the new power system under actual operating conditions.

3.18 PAINTING AND FINISHING

Field-applied paint on exposed surfaces shall be provided under Section 09900 - PAINTING, GENERAL.

3.19 REPAIR OF EXISTING WORK

The work shall be carefully laid out in advance, and where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceiling, or

other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, this work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved at no additional cost to the Government.

3.20 FIELD TESTING

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 10 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspection recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. All field test reports will be signed and dated by the Contractor.

3.20.1 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.20.2 Ground-Resistance Tests

The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE Std 81. Soil resistivity in the area of the grid shall be measured concurrently with the grid measurements. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 24 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

- a. Ground electrode system - 10 ohms.

3.20.3 Ground-Grid Connection Inspection

All below-grade ground-grid connections will be visually inspected by the Contracting Officer before backfilling. The Contractor shall notify the Contracting Officer 24 hours before the site is ready for inspection.

3.20.3.1 Low Voltage Cable Tests

- a. Continuity test.

3.20.4 Motor Tests

- a. Phase rotation test to ensure proper directions.
- b. Operation and sequence of reduced voltage starters.

- c. Insulation resistance of each winding to ground.
- d. Vibration test.

3.20.5 Dry-Type Transformer Tests

The following field tests shall be performed on all dry-type transformers

- a. Insulation resistance test phase-to-ground, each phase.
- b. Turns ratio test.

3.20.6 Circuit Breaker Tests

The following field tests shall be performed on circuit breakers.

3.20.6.1 Circuit Breakers, Low Voltage

- a. Insulation resistance test phase-to-phase, all combinations.
- b. Closed breaker contact resistance test.
- c. Manual and electrical operation of the breaker.

3.20.6.2 Circuit Breakers, Molded Case

- a. Insulation resistance test phase-to-phase, all combinations.
- b. Closed breaker contact resistance test.
- c. Manual operation of the breaker.

3.20.7 Protective Relays

Protective relays shall be visually and mechanically inspected, adjusted, tested, and calibrated in accordance with the manufacturer's published instructions. These tests shall include pick-up, timing, contact action, restraint, and other aspects necessary to insure proper calibration and operation. Relay settings shall be implemented in accordance with the coordination study. Relay contacts shall be manually or electrically operated to verify that the proper breakers and alarms initiate. Relaying current transformers shall be field tested in accordance with IEEE C57.13.

3.21 OPERATING TESTS

After the installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the specified requirements. An operating test report shall be submitted in accordance with paragraph FIELD TEST REPORTS.

3.22 FIELD SERVICE

3.22.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of number of hours recommended by the manufacturer, of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations.

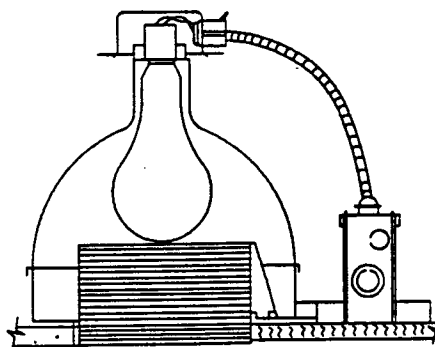
3.22.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of equipment, assist in the performance of the onsite tests, oversee initial operations, and instruct personnel as to the operational and maintenance features of the equipment.

3.23 ACCEPTANCE

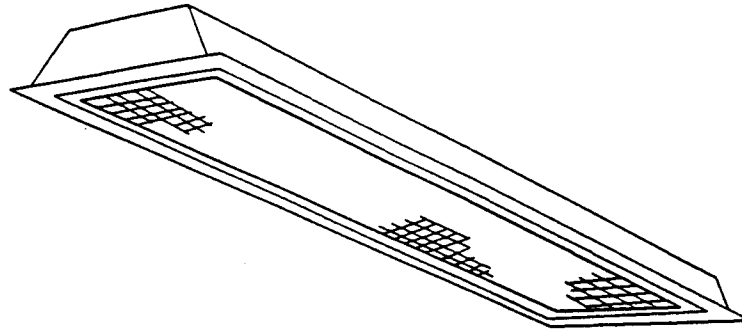
Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

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Types "G"**TYPE 116****Recessed Round Incandescent Downlight**

Fixture shall conform to UL 1571. Fixture shall have thermal protection or shall be UL listed as suitable for use in direct contact with insulation. Fixture shall be rated for a 200 watt lamp. The mounting plate shall be steel. The reflector shall be highly polished aluminum. The baffle shall be black, constructed of aluminum, and multigrooved for low brightness. The baffle shall be securely attached to the fixture housing and shall be easily removed without the use of tools. Fixture shall be provided with a through wiring junction box and shall be prewired.

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.



TYPE "D, & DE"

TYPE 204
Static Troffer

TYPE 205
Air Handling Troffer

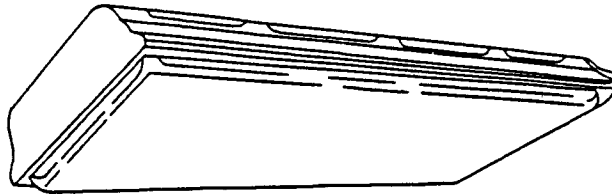
Recessed Fluorescent Fixture, 1-foot by 4-foot

First Suffix	Second Suffix	Third Suffix	Description
A			Single lamp
B			Two lamp
	1		Prismatic acrylic lens
	2		1/2- by 1/2- by 1/2-inch acrylic cube louver
	3		1/2- by 1/2- by 1/2-inch polystyrene cube louver
		A	Type 200 emergency unit

Fixture shall conform to UL 1570. Housing shall be complete with integral side trim flanges. Housing and trim flanges shall be cold-rolled steel. The lens or louver shall be installed in a manner that will prevent it from coming loose due to vibration. The ballast and wiring shall be enclosed in a wireway that is continuous throughout the length of the fixture and which forms a wireway for circuits through the fixture. All metal parts shall receive a rust inhibitive coating before application of the finish coat. The finish coat shall be baked white enamel. Lenses and acrylic cube louvers shall be 100 percent virgin acrylic plastic. The lens or louver shall be four feet in length. Acrylic lens shall be flat, 0.125 inch nominal thickness, low brightness, with smooth top surface and a lower surface having a regular array of prismatic elements. Single-lamp ballast shall be used for individually mounted single-lamp fixtures and where single-lamp fixtures occur at the ends of continuous rows, except two-lamp ballasts shall be used for tandem mounted single-lamp fixtures. Standard ballast(s) shall be the Class P, high power factor type which has been approved for the application by the Certified Ballast Manufacturers. Fixture shall be prewired.

Fixture types indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.

TYPES : B & C



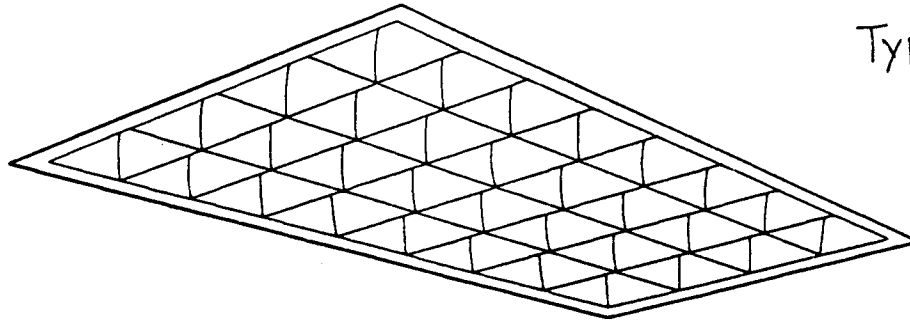
TYPE 212

Recessed Static Fluorescent Fixture, 2-foot by 4-foot, With Drop Opal Lens

First Suffix	Second Suffix	Description
A		Two lamps
B		Three lamps
C		Four lamps
	1	Type 200 emergency unit

Fixture shall conform to UL 1570. Housing shall be complete with integral side trim flanges. Housing and trim flanges shall be cold-rolled steel. The lens shall be installed in a manner that will prevent it from coming loose due to vibration. The ballasts and wiring shall be enclosed in a wireway that is continuous throughout the length of the fixture and which forms a wireway for circuits through the fixture. All metal parts shall receive a rust inhibitive coating before application of the finish coat. The finish coat shall be baked white enamel. Two-lamp ballasts shall be used for individually mounted two-lamp and four-lamp fixtures. Standard ballast(s) shall be the Class P, high power factor type which has been approved for the application by the Certified Ballast Manufacturers. Fixture shall be prewired.

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.



TYPES: A, A1 & A2

TYPE 234
Static Troffer

TYPE 235
Air Handling Troffer

TYPE 236
Heat Removal/
Transfer Troffer

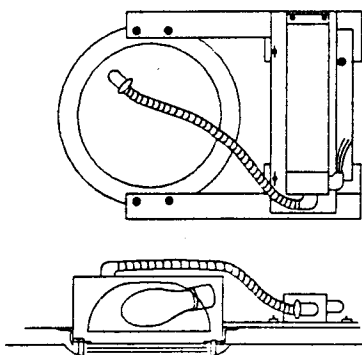
Recessed Fluorescent Fixture, 2-foot by 4-foot, With Parabolic Louver

First Suffix	Second Suffix	Description
A		Two-lamp, 12-cell louver
B		Three-lamp, 18-cell louver
C		Four-lamp, 32-cell louver
	1	Type 200 emergency unit

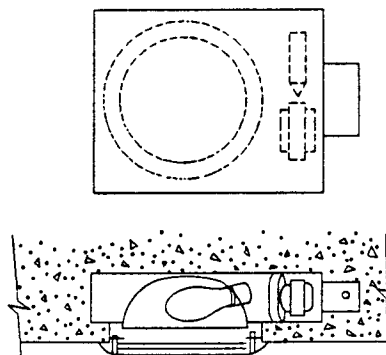
Fixture shall conform to UL 1570. Housing, trim flanges if any, shall be die-formed, cold-rolled steel embossed if necessary to ensure structural rigidity. Metal parts to be painted shall receive one or more rust inhibitive coatings before application of the finish coat. Reflective surfaces shall be finished to provide an initial and minimum reflectance of not less than 85 percent. The louver shall be the anodized or semi-specular finished aluminum type consisting of inter-connected cellular baffles not less than three nor more than four inches in depth. The louver shall be hinged on either longitudinal side using die-formed steel hinges, and shall be held securely in place by the hinges and spring-steel latches that are inconspicuous or concealed from view when louver is in place and latches are closed. Securing the louver in place shall prevent light leakage and movement of the louver when subjected to normal vibrations. The ballast(s) and fixture wiring shall be concealed by a snap-in type of metal cover which can be removed and replaced without the use of tools. Standard ballast(s) shall be of the Class P, high power factor type that has been approved by the Certified Ballast Manufacturers for the application. Ballast(s), lampholders, louver and the wireway cover shall be removable and replaceable without removal of the fixture from the ceiling. Fixture shall be prewired.

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.

Type: F



TYPE 308
Plaster Ceiling Installation



TYPE 309
Poured Concrete Installation

Enclosed and Gasketed, Recessed, Round,
Integrally Ballasted, Mercury Vapor Fixture

First Suffix	Second Suffix	Description
A		Flat prismatic glass diffuser
B		Flat white glass diffuser
C		Drop homogeneous glass diffuser
D		Drop prismatic glass diffuser
	1	Baked white enamel exterior trim
	2	Brushed aluminum exterior trim

Fixture shall conform to UL 1572 and shall be rated for use in damp locations. Fixture housing shall be galvanized steel. The interior shall be finished with baked white enamel. The reflector shall be aluminum with the manufacturer's standard commercial product finish suitable for the lamp type and rating. The fixture shall be gasketed to prevent the entry of insects and light leakage. The lens framing shall be one-piece cast aluminum, 10-inch nominal diameter, finished as specified or indicated, and shall be held to the fixture housing with captive screws of same finish as lens trim. Ballast shall be of the high power factor type. The fixture ballast shall be of the constant wattage autotransformer type rated to operate one 100 watt mercury vapor lamp. The ballast shall be capable of starting and operating the lamp at ambient temperatures from minus 20 degrees F to 105 degrees F. Fixture depth for type 309 shall not exceed 7 inches. The fixture shall be prewired and shall have a glazed porcelain lampholder.

Fixture types indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.

SECTION 16640 - CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS (NACE)

NACE RP0169 (1992) Control of External Corrosion on
Underground or Submerged Metallic Piping Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

1.2 GENERAL REQUIREMENTS**1.2.1 Services of Corrosion Engineer**

The Contractor shall obtain the services of a corrosion engineer to design, supervise, and inspect the installation of the cathodic protection system. Corrosion Engineer refers to a person, who, by reason of his knowledge of the physical sciences and the principles of engineering and mathematics, acquired by professional education and related practical experience, is qualified to engage in the practice of corrosion control on buried or submerged metallic piping systems and metallic tanks. Such person may be a licensed professional engineer or may be a person certified as being qualified by the National Association of Corrosion Engineers if such licensing or certification includes suitable experience in corrosion control on buried or submerged metallic piping systems and metallic tanks. The corrosion engineer shall insure that the cathodic protection system is installed, tested, and placed into service in accordance with the requirements specified.

1.2.2 Rules

The installation shall conform to the applicable rules of NFPA 70. The design and installation shall conform to the applicable rules of NACE RP0169.

1.2.3 Extent of Work

The cathodic protection system shall be designed and installed to provide cathodic protection to all ferrous metal components installed below or in contact with the ground.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-01 Data

Cathodic Protection System; FIO.

Manufacturer's Catalog Data.

Qualifications; FIO.

Evidence of qualifications of the corrosion engineer.

SD-04 Drawings

Cathodic Protection System; FIO.

Detail drawings consisting of a complete list of equipment and material including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Detail drawings shall contain complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will function properly as a unit.

SD-09 Reports

Tests and Measurements; GA

Test reports in booklet form tabulating all field tests and measurements performed, upon completion and testing of the installed system.

PART 2 - PRODUCTS

2.1 MATERIALS

Materials shall comply with manufacturer's and corrosion engineer's recommendations.

PART 3 - EXECUTION

3.1 INSTALLATION

Unless otherwise indicated, all equipment shall be installed in accordance with the manufacturer's and corrosion engineer's recommendations.

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SECTION 16721

FIRE DETECTION AND ALARM SYSTEM

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C135.30	(1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction
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FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825	(1998) Approval Guide
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INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991) Surge Voltages in Low-Voltage AC Power Circuits
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code
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NFPA 72	(1996) National Fire Alarm Code
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NFPA 90A	(1993) Installation of Air Conditioning and Ventilating Systems
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UNDERWRITERS LABORATORIES (UL)

UL-04	(1998) Fire Protection Equipment Directory
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UL 6	(1993) Rigid Metal Conduit
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UL 38	(1994; Rev Jan 1994) Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems
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UL 228	(1993) Door Closers-Holders, with or without Integral Smoke Detectors
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UL 268	(1989; Rev May 1989) Smoke Detectors for Fire Protective Signaling Systems
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UL 464	(1990) Audible Signal Appliances
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UL 467	(1993) Grounding and Bonding Equipment
UL 521	(1993) Heat Detectors for Fire Protective Signaling Systems
UL 797	(1993) Electrical Metallic Tubing
UL 864	(1991; Rev thru May 1994) Control Units for Fire-Protective Signaling Systems
UL 1242	(1983; Rev thru Jul 1993) Intermediate Metal Conduit

1.2 GENERAL REQUIREMENTS

1.2.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products. All new devices shall be compatible with the existing Multiplex 5000 System, as manufactured by Johnson Controls.

1.2.2 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verifying all requirements with the existing system, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.2.3 Compliance

The equipment furnished shall be compatible with the existing system and shall be UL listed or FM approved.

1.2.4 Manufacturer's Services

Services of a manufacturer's representative who is experienced in the installation, adjustment, testing, and operation of the equipment specified shall be provided. The representative shall supervise the installation, adjustment, and testing of the equipment.

Government approval is required for submittals with a "GA" designation; submittals having an "FI0" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-01 Data

Battery; GA.

A new battery(s) shall be furnished for the existing system. Substantiating battery calculations for supervisory and alarm power requirements shall be submitted. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included.

Qualifications; FI0.

Qualifications, with verification of experience and license number, of a Registered Professional Engineer with at least 4 years of current experience in the design of the fire protection and detection systems. This engineer must perform the various specification items required by this section to be performed by a registered Professional Engineer.

SD-04 Drawings

Fire Alarm Reporting System; GA.

Detail drawings, signed by the Registered Professional Engineer, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. The contractor shall check the layout based on the actual detectors to be installed and make any necessary revisions in the detail drawings. The detail drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit.

Detailed point-to-point wiring diagram, signed by the Registered Professional Engineer, showing all points of connection. Diagram shall include connections between new and existing system devices.

SD-06 Instructions

Fire Alarm Reporting System; GA.

Three copies of operating and maintenance instructions shall be provided.

SD-09 Reports

Testing; FI0.

Test reports in booklet form showing all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the system. Each test report shall document all readings, test results and indicate the final position of controls.

Installer; FI0.

The Contractor shall provide documentation demonstrating that its fire detection and alarm system installer has been regularly engaged in the installation of fire detection and alarm systems meeting NFPA standards for a minimum of three years immediately preceding commencement of this contract. Such documentation shall specifically include proof of satisfactory performance on at least three projects similar to that required by these specifications, including the names and telephone numbers of using agency points of contact for each of these projects. Documentation shall indicate the type of each system installed and include a written certificate that each system has performed satisfactorily in the manner specified for a period of not less than 12 months following completion. All such data shall be submitted 30 days prior to commencement of installation for approval of the

Contracting Officer. Listing of the installer under "Protective Signaling Services - Local, Auxiliary, Remote Station Proprietary (UUJS)" of UL-04 shall be accepted as equivalent proof of compliance with the foregoing experience requirements.

1.3 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, and any other contaminants.

PART 2 - PRODUCTS

2.1 STORAGE BATTERIES

Storage Batteries shall be provided and shall be the sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 48 hours. Following this period of operation via batteries, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Batteries shall be sized to deliver 50 percent more ampere/hours based on a 48 hour discharged rate than required for the calculated capacities.

2.2 MANUAL FIRE ALARM STATIONS

Manual fire alarm stations shall conform to the applicable requirements of UL 38. Manual stations shall be compatible with the existing system. Stations shall be double action type and be installed on semi-flush mounted outlet boxes. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. Stations shall have a separate screw terminal for each conductor. Surface mounted boxes shall be painted the same color as the fire alarm manual stations. Addressable pull stations shall be capable of being field programmed, shall latch upon operation and remain latched until manually reset.

2.3 FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, and UL 521. The detectors shall be provided as indicated. Detector base shall have screw terminals for making connections. No solder connections will be allowed. Detectors shall be connected into alarm initiating circuits. Detectors located in concealed locations (above ceiling, etc.) shall have a remote visible indicator lamp.

2.3.1 Smoke Detectors

Detectors shall be designed for detection of abnormal smoke densities. Smoke detectors shall be compatible with existing system. Detectors shall contain a visible indicator lamp that shows when the unit is in alarm condition.

Detectors shall not be adversely affected by vibration or pressure. Detectors shall be the plug-in type in which the detector base contains terminals for making all wiring connections.

2.3.1.1 Photoelectric Detectors

Detectors shall operate on a light scattering concept using an LED light source. Failure of the LED shall not cause an alarm condition. Detectors shall be factory set for sensitivity and shall require no field adjustments of any kind. Detectors shall have an obscuration rating between 1.9 and 2.4 percent per foot when tested in accordance with UL 26.

2.3.1.2 Tamper Proof Smoke Detector Guard

Sensor guard shall have heavy duty, double wall steel construction (16 gauge steel minimum) with staggered hole placement which shall compensate for air flow restriction by providing maintained high sensitivity (0.5 to 1%/foot obstruction). Sensor guard shall have beveled solid edges for high security for ceiling or wall mounting with hinged cover for sensor access. Guard shall be installed with stainless steel tamper resistant mounting screws.

2.4 NOTIFICATION APPLIANCES

Audible appliances shall be heavy duty and conform to the applicable requirements of UL 464. Devices shall be connected into alarm indicating circuits and shall have a separate screw terminal for each conductor. Devices shall have manufacturer's standard finish and color.

2.4.1 Chimes

Chimes shall be electrically operated, supervised, single stroke, heavy-duty type with polished tone bar and resonator to sound fire alarm code signals. Chimes shall have a minimum sound rating of 80 dBA at 3.048 m (10 feet).

2.4.2 Visual Notification Appliances

Visual notification appliances shall have high intensity optic lens and flash tubes. Strokes shall flash at approximately 1 flash per second and a minimum of 1 candela (8,000 peak candle power).

2.4.3 Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances shall provide the same requirements as individual units except they shall mount as a unit in standard backboxes. All units shall be factory assembled. Any other audible indicating appliance employed in the fire alarm systems shall be approved by the authority having jurisdiction.

2.5 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

2.5.1 Ground Rods

Ground rods shall be of zinc-coated steel conforming to ANSI C135.30 not less than 3/4 inch in diameter by 10 feet in length.

2.5.2 Conduit

Conduit and fittings shall comply with UL 6, UL 1242 and UL 797.

2.5.3 Wiring

Wiring for 120V ac power shall be No. 12 AWG minimum. Wiring for low voltage dc circuits shall be No. 14 AWG minimum. Power wiring (over 28 volts) and control wiring shall be isolated. All wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except rigid plastic conduit may be used under slab-on-grade. All conductors shall be color coded. Conductors used for the same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to alarm initiating, supervisory circuits, and alarm indicating circuits are prohibited. T-tapping using screw terminal blocks is allowed for addressable systems.

PART 3 - EXECUTION

3.1 INSTALLATION

All work shall be installed as shown and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Smoke detectors shall not be installed until the building has been thoroughly cleaned.

3.1.1 Wiring

Conduit size for wiring shall be in accordance with NFPA 70. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. No more than one conductor shall be installed under any screw terminal. All circuit conductors entering or leaving any mounting box, outlet box enclosure or cabinet shall be connected to screw terminals with each terminal marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors are prohibited in the system. Wiring within any control equipment shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

3.1.2 Detectors

Detectors shall be installed in accordance with NFPA 72. Detectors shall be at least 12 inches from any part of any lighting fixture. Detectors shall be located at least 3 feet from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in free space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 3 feet, sway bracing shall be provided.

3.1.3 Notification Appliances

Notification appliances shall be mounted a minimum of 8 feet above the finished floor unless limited by ceiling height or otherwise indicated.

3.1.4 Annunciator Equipment

Annunciator equipment provided shall be mounted where indicated.

3.2 OVERVOLTAGE AND SURGE PROTECTION

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 and NFPA 70. All cables and conductors which serve as communications links, except fiber optics, shall have surge protection circuits installed at each end. Fuses shall not be used for surge protection.

3.3 GROUNDING

Grounding shall be provided to building ground or ground rods shall be driven. Maximum impedance to ground shall be 10 ohms. Ground rods shall not protrude more than 6 inches above grade.

3.4 TESTING

The Contractor shall notify the Contracting Officer 14 days before the preliminary and acceptance tests are to be conducted. The tests shall be performed in accordance with the approved test procedures in the presence of the Contracting Officer. The control panel manufacturer's representative shall be present to supervise all tests. The Contractor shall furnish all instruments and personnel required for the tests.

3.4.1 Preliminary Tests

Upon completion of the installation, the system shall be subjected to functional and operational performance tests. Tests shall include the meggering of all system conductors to determine that the system is free from grounded, shorted, or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. If deficiencies are found, corrections shall be made and the system shall be retested to assure that it is functional.

3.4.2 Acceptance Test

Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that all previous deficiencies have been corrected. The test shall include the following:

- a. Visual inspection of all wiring connections.
- b. Test of each circuit in both trouble and normal modes.
- c. Tests of alarm initiating devices in both normal and trouble conditions.

- d. Tests of each control circuit and device.
- e. Tests of each alarm notification appliance.
- f. Tests of the battery charger and batteries.
- g. Complete operational tests under emergency/standby power supply.
- h. Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.

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SECTION 16741 - PREMISES DISTRIBUTION SYSTEM AND TELEPHONE

PART 1 - GENERAL**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA 568A	(1991) Commercial Building Telecommunications Wiring Standard
EIA 569	(1990) Commercial Building Standard for Telecommunications Pathways and Spaces
EIA 606	(1993) Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
EIA 607	(1994) Grounding and Bonding Requirements for the Telecommunications Infrastructure of Commercial Buildings
EIA TSB 67	Transmission Performance Specifications for Field Testing of UTP Cabling Systems

IBM CORPORATION PUBLICATION (IBM)

IBM GA27-3361-07	(1987) LAN Cabling System - Planning and Installation
IBM GA27-3773-1	(1987) Cabling System Technical Interface Specifications

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-80-576	(1994) Communications Wire and Cable for Wiring of Premises
ICEA S-83-596	(1994) Fiber Optic Premises Distribution Cable

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996) National Electrical Code
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UNDERWRITERS LABORATORY (UL)

UL 50	(1995) Enclosures for Electrical Equipment
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1.2 SYSTEM DESCRIPTION

The premises distribution system shall consist of inside-plant horizontal, riser, and backbone cables and connecting hardware to transport LAN and telephone signals between equipment items in a building.

1.3 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 0 to 60 degrees C and in the range of 0 to 95 percent relative humidity, noncondensing.

1.4 QUALIFICATIONS

1.4.1 Minimum Contractor Qualifications

All work under this section shall be performed by and all equipment shall be furnished and installed by a certified telecommunications contractor, hereafter referred to as the Contractor. With the exception of furnishing and installing conduit, electrical boxes, and pullwires. The Contractor shall have the following qualifications in Telecommunications Systems installation:

a. Contractor shall have a minimum of 3 years experience in the application, installation and testing of the specified systems and equipment.

b. All supervisors and installers assigned to the installation of this system or any of its components shall have factory certification from each equipment manufacturer that they are qualified to install and test the provided products. General electrical trade staff (electricians) shall not be used for the installation of the premises distribution system cables and associated hardware.

c. All installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper cable and components.

1.4.2 Minimum Manufacturer Qualifications

The equipment and hardware provided under this contract will be from manufacturers that have a minimum of 3 years experience in producing the types of systems and equipment specified.

1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES:

SD-01 Data

Spare Parts; FIO.

Lists of spare parts, tools, and test equipment for each different item of material and equipment specified, after approval of detail drawings, not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking. The horizontal category 5 copper cable shall be provided with all pairs insulated with chemically identical material. This cable is sometimes referred to as type 4 X 0 .

SD-04 Drawings

Premises Distribution System; GA.

Detail drawings including a complete list of equipment and material. Detail drawings shall contain complete wiring and schematic diagrams and other details required to demonstrate that the system has been coordinated and will function properly as a system. Drawings shall include vertical riser diagrams, equipment rack details, elevation drawings of telecommunications closet walls, outlet face plate details for all outlet configurations, sizes and types of all cables, conduits, and cable trays. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation. System drawings and records showing final configuration, including location, type, block, panel and terminal assignment of cabling in accordance with EIA 606, and floor plan layout of the equipment room.

SD-06 Instructions

Manufacturer's Recommendations; FIO.

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations, prior to installation shall be provided. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

SD-08 Statements

Test Plan; FIO.

Test plan defining the tests required to ensure that the system meets technical, operational and performance specifications, 60 days prior to the proposed test date. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested, and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

Qualifications; GA.

The qualifications of the Manufacturer(s), Contractor(s), and the Installer(s) to perform the work specified herein. This shall include proof of the minimum qualifications specified herein.

SD-09 Reports

Test Reports; FIO.

Test reports in booklet form with witness signatures verifying execution of tests. Test results will also be provided on 89 mm diskettes in ASCII format. Reports shall show the field tests performed to verify compliance with the specified performance criteria. Test reports shall include record of the physical parameters verified during testing. Test reports shall be submitted within 14 days after completion of testing.

SD-13 Certificates

Premises Distribution System; FIO.

Written certification that the premises distribution system fully complies with the EIA 568, EIA 569, EIA 606, EIA TSB 67 standards.

Materials and Equipment; FIO.

Where materials or equipment are specified to conform, be constructed or tested to meet specific requirements, certification that the items provided conform to such requirements. Certification by a nationally recognized testing laboratory that a representative sample has been tested to meet the requirements, or a published catalog specification statement to the effect that the item meets the referenced standard, will be acceptable as evidence that the item conforms. Compliance with these requirements does not relieve the Contractor from compliance with other requirements of the specifications.

Installers; FIO.

The Contractor shall submit certification that all the installers are factory certified to install and test the provided products.

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust or other contaminants.

1.7 OPERATION AND MAINTENANCE MANUALS

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance for all products provided as a part of the premises distribution system. Specification sheets for all cable, connectors, and other equipment shall be provided.

PART 2 - PRODUCTS**2.1 MATERIALS AND EQUIPMENT**

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 1 year prior to installation. Materials and equipment shall conform to the respective publications and other requirements specified below and to the applicable requirements of NFPA 70.

2.2 UNSHIELDED TWISTED PAIR CABLE SYSTEM**2.2.1 Horizontal Cable**

Horizontal cable shall meet the requirements of EIA 568 and EIA TSB 36 for Category 5, four unshielded twisted pair, horizontal cable. Cable shall all be installed in EMT conduit. Cable shall be label-verified. Cable shall have a teflon jacket and shall be factory marked at regular intervals indicating verifying organization and performance level. Conductors shall be solid untinned copper 24 AWG. Cable shall be rated CMG per NFPA 70.

2.2.2 Connecting Hardware

Connecting and cross-connecting hardware shall be the same category as the cable it serves. Hardware shall be in accordance with and EIA 568 and EIA TSB 40-A.

2.2.2.1 Telecommunications Outlets

Wall and desk outlet plates shall come equipped with standard IMO faceplate that can support up to three dual-information outlets. Each outlet shall be numbered for easy identification of type and location such as the two top modular jacks, labeled "Data A" and "Data B" respectively, and the bottom jack labeled "voice". Modular jacks shall be eight wire for LAN, shall be the same category as the cable they terminate and shall meet the requirements of EIA 568 and EIA TSB 40-A. Modular jack pin/pair configuration shall be T568A per EIA 568 and EIA TSB 40-A. Modular jacks shall be unkeyed. Faceplates shall be provided and shall be stainless steel. Outlet assemblies used in the premises distribution system shall consist of modular jacks assembled into both simplex and duplex outlet assemblies in single or double gang covers as specified in this section and as indicated on the drawings. The modular jacks shall conform to the requirements of EIA 568, EIA TSB 40-A, Category 5.

2.2.2.2 Patch Panels

Patch panels shall consist of eight-position modular RJ-45 jacks for Category 5 installation, with rear mounted type 110 insulation displacement connectors, arranged in rows or columns on 19 inch L by 1 3/4 inches H, black color, rack mounted panels. Jack pin/pair configuration shall be T568A per EIA 568 and EIA TSB 36. Jacks shall be unkeyed. Panels shall be provided with labeling space.

2.2.2.3 Terminal Blocks

Terminal blocks shall be rack mounted wire termination units consisting of insulation displacement connectors mounted in plastic blocks, frames or housings. Blocks shall be type 110 which meet the requirements of EIA 568 and EIA TSB 40-A for category 5. Blocks shall be mounted on standoffs and shall include cable management hardware. Insulation displacement connectors shall terminate 22, 24, or 26 gauge solid copper wire, and shall be connected in pairs so that horizontal cable and connected jumper wires are on separate connected terminals.

2.2.2.4 Telephone Crossconnect Blocks

Modular punch down, 66 or 110 type, termination blocks shall be provided to terminate all subscriber lines. Crossconnect blocks shall be Category 5 verified listed by UL.

2.2.2.5 Telephone Backboards

The backboards shall be 3/4 inch plywood having a two-coat insulating varnish finish and shall be sized as shown on the drawings.

2.3 EQUIPMENT RACKS

2.3.1 Cable Guides

Cable guides shall be specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on 19 inch equipment racks. Cable guides shall consist of ring or bracket-like devices mounted on rack panels for horizontal use or individually mounted for vertical use. Cable guides shall mount to racks by screws and/or nuts and lockwashers.

2.4 TELECOMMUNICATIONS OUTLET BOXES

Electrical boxes for telecommunication outlets shall be 4-11/16" square by 2-1/8" deep with minimum 1/4" deep single or two gang plaster ring as shown. Provide a minimum 1" conduit.

PART 3 - EXECUTION

3.1 INSTALLATION

System components and appurtenances shall be installed in accordance with NFPA 70, manufacturer's instructions and as shown. Necessary interconnections, services, and adjustments required for a complete and operable signal distribution system shall be provided. Components shall be labeled in accordance with EIA 606. Penetrations in fire-rated construction shall be firestopped in accordance with Section 07840 - FIRESTOPPING. Conduits, outlets and raceways shall be installed in accordance with Section 16415 - ELECTRICAL WORK, INTERIOR. Wiring shall be installed in accordance with EIA 568 and as specified in Section 16415 - ELECTRICAL WORK, INTERIOR. Wiring,

and terminal blocks and outlets shall be marked in accordance with EIA 606. Cables shall not be installed in the same cable tray, utility pole compartment, or floor trench compartment with ac power cables. All cables shall be installed in EMT conduit.

3.1.1 Horizontal Distribution Cable

The rated cable pulling tension shall not be exceeded. Cable shall not be stressed such that twisting, stretching or kinking occurs. Cable shall not be spliced. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 12 inches shall be maintained when such placement cannot be avoided. Cables shall be terminated; no cable shall contain unterminated elements. Minimum bending radius shall not be exceeded during installation or once installed. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered.

3.1.2 Telecommunications Outlets

3.1.2.1 Faceplates

As a minimum each jack shall be labeled as to its function and a unique number to identify cable link.

3.1.2.2 Cables

Unshielded twisted pair and fiber optic cables shall have a minimum of 6" of slack cable loosely coiled into the telecommunications outlet boxes. Minimum manufacturers bend radius for each type of cable shall not be exceeded.

3.1.3 Terminal Blocks

Terminal blocks shall be mounted in orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Industry standard wire routing guides shall be utilized.

3.1.4 Unshielded Twisted Pair Patch Panels

Patch panels shall be mounted in equipment racks with sufficient modular jacks to accommodate the installed cable plant plus 10 percent spares. Cable guides shall be provided above, below and between each panel.

3.1.5 Equipment Racks

Cable guides shall be bolted or screwed to racks. Racks shall be installed level in designated locations with a minimum clear space of 600 mm (24 inches) in both front and back.

3.1.6 Rack Mounted Equipment

Equipment to be rack mounted shall be securely fastened to racks by means of the manufacturer's recommended fasteners.

3.1.7 Telephone Cables

Cable shall be continuous from each telephone outlet to backboard indicated on the drawings. Splicing of individual cables shall not be permitted. At each outlet, cable shall be terminated on the modular jack assembly, using color code provided by the Contracting Officer. At the backboard, terminate the cable on cross-connect terminal blocks and mark with the appropriate outlet number.

3.1.8 Crossconnect Blocks

The blocks shall be attached to right side of the plywood telephone backboard in vertical rows.

3.1.9 Telephone Backboards

Telephone backboards shall be installed at locations shown on the drawings.

3.1.10 Building Entry Protection Modules

Building Entry Protection Modules shall be provided to terminate the building feeder cable. The modules shall be attached to the left side of the telephone backboard.

3.1.11 TELEPHONE WIRING SYSTEM

The telephone wiring system shall be complete and functional.

3.1.12 Auxiliary Devices

All auxiliary devices such as tie bars, cable rings, etc. which are not shown but are required for a high grade installation shall be provided.

3.2 TERMINATION

Cables and conductors shall sweep into termination areas; cables and conductors shall not bend at right angles. Manufacturer's minimum bending radius shall not be exceeded. When there are multiple system type drops to individual workstations, relative position for each system shall be maintained on each system termination block or patch panel.

3.2.1 Unshielded Twisted Pair Cable

Each pair shall be terminated on appropriate outlets, terminal blocks or patch panels. No cable shall be unterminated or contain unterminated elements. Pairs shall remain twisted together to within the proper distance from the termination as specified in EIA TSB 40-A. Conductors shall not be damaged when removing insulation. Wire insulation shall not be damaged when removing outer jacket.

3.3 GROUNDING

Signal distribution system ground shall be installed in the telecommunications entrance facility and in each telecommunications closet in accordance with EIA 607 and Section 16415 - ELECTRICAL WORK, INTERIOR. Equipment racks shall be connected to the electrical safety ground.

3.4 ADDITIONAL MATERIALS

The Contractor shall provide the following additional materials required for facility startup.

- a. 10 of each type outlet.
- b. 10 of each type cover plate.
- c. 1 of each type terminal block for each telecommunications closet.
- d. 4 Patch cords of 10 feet for each telecommunications closet.
- e. 1 Set of any and all special tools required to establish a cross connect and to change and/or maintain a terminal block.

3.5 TESTING

Materials and documentation to be furnished under this specification are subject to inspections and tests. All components shall be terminated prior to testing. Equipment and systems will not be accepted until the required inspections and tests have been made, demonstrating that the signal distribution system conforms to the specified requirements, and that the required equipment, systems, and documentation have been provided.

3.5.1 Unshielded Twisted Pair Tests

All metallic cable pairs shall be tested for proper identification and continuity. All opens, shorts, crosses, grounds, and reversals shall be corrected. Correct color coding and termination of each pair shall be verified in the communications closet and at the outlet. Horizontal wiring shall be tested from and including the termination device in the communications closet to and including the modular jack in each room. These test shall be completed and all errors corrected before any other tests are started.

3.5.2 Category 5 Circuits

All category 5 circuits shall be tested using a test set that meets the Class II accuracy requirements of EIA TSB 67 (Draft) standard. Testing shall use the Basic Link Test procedure of EIA TSB 67. Cables which contain failed circuits shall be replaced and retested to verify the standard is met.

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